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VIEWS, NEWS AND INTERVIEWS.

The electrical press has already recommended the use of a moderately old incandescent lamp, in preference to a new lamp, for those who have occasion to use the electric light. Oculists recommend that people troubled by glaring sunlight wear smoked and not blued glasses. It has been asked, "Why not use a smoked glass globe instead of surrounding the incandescent light with ground glass?"—in other words, let the electric light rather than the eyes wear the spectacles.

Sir William Thomson has expressed his disapproval of the English method of steamship wiring for electric lights. In a recent address the distinguished speaker said that observation has shown that the single wire system has produced an error in ships' compasses of from three to seven degrees, in spite of every precaution. Sir William declared the argument, that the iron hull which completes the circuit in a single wire system protects the compass from the deflecting influence of the current, was fallacious. In the conning tower of the English man of-war "Orlando," which is belted with iron one foot thick, the terrestrial magnetic force on the compass is only reduced to one-fifth of what it is outside.

The present strength of the arc light, which Mr. David Charteris has placed upon his model of the Eddystone Lighthouse, in the Chelsea, England, Naval Exhibition, is about 2,000,000 candle power. Mr. Charteris hopes to be able to raise it to five or seven million candle-power.

In the hearing which the Massachusetts Railroad Commissioners granted to the West End Street Railway Company, some interesting facts regarding the equipment of the road were brought out. Mr. Thomas Doane said that he had examined the entire road (256 miles) and had counted 1,046 curves and 350 cross-overs connecting the two tracks, making a total of 1,396 curves in the whole road. Mr. Doane's figures show that the construction value of one mile of the straight track is $4,016 for metal, including track, ties, stringers, etc. The cost for electric cars is $7,454 per mile of straight track, and $12,582 per mile for curved track.

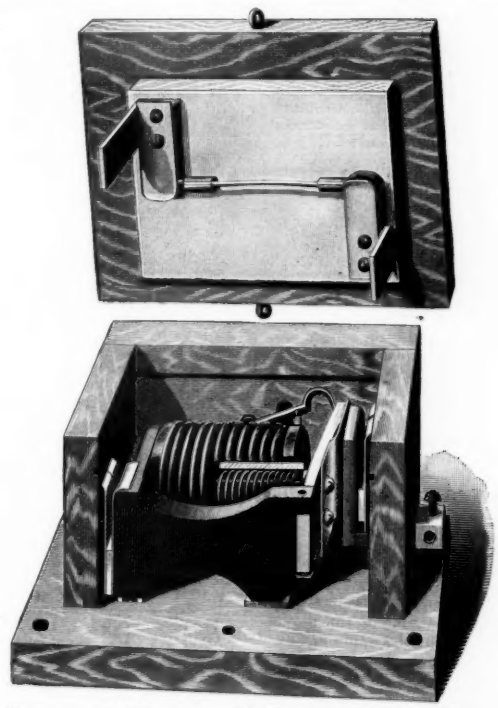
The Edison General Electric Company has issued a neat advertising picture. It represents a man at a desk talking to a friend. On top of the desk is an electric fan, revolving at a high rate of speed—so high, in fact, as to condense the air in solid chunks. Everything is standing out straight, the whiskers of the friend flowing back from his shoulders in graceful waves. A dog is seen in the background trying to make headway against the fearful current. The significant motto, "Keep Cool By Using Edison Electric Fans," explains the picture.

One of the items of revenue of the Brooklyn bridge is a yearly rental of $13,000 from telegraph and telephone companies, for allowing their cables to lie on hard iron stringers. An expensive bed, indeed.

A Magnetic Cut-Out for Railway Motors.

The rapid change from horse cars to electric railways has created a new occupation, that of the "Motorneer." Evidently his duties are very different from that of a horse-car driver, and for good service he should have passed through a course of training which would thoroughly acquaint him with the peculiarities of railway motors and the proper handling of the same. But where the trolley system is introduced rather quickly, as is generally the case, the ordinary horse-car driver is immediately put in charge of the motor car and left to learn much from experience. Of course, this is at the risk of the electrical apparatus, and accounts in part for the frequent burning out of armatures or field coils.

To guard against this expensive ruining of the motor coils, it is merely necessary to introduce some safeguard which will positively open the circuit when the current becomes too large. The fuses commonly used for this purpose, like those in many other devices, are not to be implicitly relied on in practice. This is partly because the fuses are not always well gauged, and more so because the continued passage of a current not much below the limit of safety is apt to change the capacity of the fuse. In either case the fuse may not blow at all or may yield so slowly as to allow the motor coils to burn out first.



HARRINGTON'S MAGNETIC CUT-OUT FOR RAILWAY MOTORS.

The new magnetic cut-out designed by Mr. W. E. Harrington, of Atlantic City, N. J., avoids this risk by letting a small fuse carry the whole current when this exceeds a certain strength. For this purpose the electro-magnet shown in the cut is put in shunt with a fuse which can carry but a small fraction of the current required by the motor. When the current becomes too great the magnet attracts its armature and thereby cuts itself out, the armature being locked in this position by a spring catch.

The fuse can be quickly and cheaply replaced, and the catch released so as to make the cut-out again ready for action. A thick sheet of asbestos protects the magnet from the fused metal, and all the parts are built of ample size for good wear. This device has been perfected by George Cutter, of Chicago, who is putting it on the market.

The West End Company Sued for Infringement.

Two bills in equity were filed June 8, in the United States Circuit Court for the District of Massachusetts, against the West End Street Railway Company of Boston; one by the Sprague Electric Railway and Motor Company and the other by the Edison General Electric Company, for alleged infringements of patents held and controlled by the plaintiffs.

It is stated in the bills that the defendant has been guilty of the alleged infringements for some time past, one date being as far back as January, 1889, and the plaintiffs pray not only for an injunction, but for remuneration for past usage. An injunction will be asked to prevent the West End Company from using; first, the underground wire which is employed to connect the rails so that there may be a better conductor for the return current; second, to stop the use of guard wires; third, to practically prevent the use of trolley and feed wires; fourth, to prohibit the use of motors in parallel circuit, and last, to prevent the cutting of different sections of the line.

The suit is practically one in which the Edison General Electric Company is plaintiff and the Thomson-Houston Electric Company defendant, as it is understood that the contract between the West End Company and the Thomson-Houston Company, whose system is used, provides that the latter shall save the former from all patent litigation. The points in dispute are exceedingly broad and the court will find its time fully occupied in trying the case.

Detroit Electrical Works.

AN IMMENSE PLANT TO BE CONSTRUCTED BY THIS PROGRESSIVE COMPANY.

The Detroit Electrical Works, whose stock has been recently listed on the Boston Stock Exchange, has just closed a deal for the purchase of a tract of 16 acres of land in Detroit, Mich. The company contemplates the erection of one of the most extensive electrical manufacturing establishments in the country. The new plant will include a machine shop, foundries, pattern shops, finishing shops, steam forges, erecting shops, carpenter shops and laboratories, and a large power plant capable of furnishing an electric current for the motors of the whole manufacturing establishment. The present plant will be continued in operation.

The mechanical shop of the new works will be a large structure, and each department of the work will be entirely separated from the others. The various buildings, while not taking up the whole space of the land, will occupy a large share of it, and they will be so arranged that additions can easily be made to them.

All of the shops will be fitted up with overhead electrical traveling cranes. The intention for the next year's work is to turn out at least five complete steel car electrical equipments per day, and one complete generator, of a capacity of not less than 100 horse-power.

The cost of the buildings as now contemplated will be from $200,000 to $300,000, including the amount of machinery that will be necessary over and above what can be transferred from the old plant at the Woodward avenue railroad crossing. The plans and specifications are not yet complete, but they are expected to be finished so that work may be commenced in July and the new plant ready for operation by January 1.

Extending down the middle of the property will be two railroad tracks connected at suitable points by cross-over switches. An overhead trolley system will be erected throughout the grounds, and electrical locomotives will be used for all shifting work.

The system of electric street railway motors to be built will continue to be upon the principle of the American standard type of railroad locomotives which the Detroit Electrical Works inaugurated over a year ago. The character of the company's street car equipment will be exclusively its own. It is the first system to follow the American locomotive principle as used upon the Pennsylvania Railroad. About two years ago the Pennsylvania Company made a test to demonstrate the efficiency of the American and British principles of locomotives, and found that the American was the best. The Detroit Electrical Works' street car system is copied after this idea. It permits of one motor driving both axles at once.

The present plant is now running three hours overtime, besides employing the entire facilities of the Dry-Dock Engine Works in turning out the different mechanical parts of new equipment.

Louis Warfield, lately of the Pennsylvania Railroad Company, is now general manager and treasurer of the company. The other officers are: President, Hugh McMillan; vice-president, William A. Jackson; secretary, William H. Wells.

The Spanish Minister of Colonial Finances states that he is considering the advisability of inviting tenders for the laying of an Atlantic cable between Spain and the Island of Porto Rico. The contract will not be awarded without an opportunity for competition.

The Polar Diagram of Alternate Currents and Its Application to Inductive Resistances.

BY CHAS. STEINMETZ.

Electrical engineering is an achievement of the most modern time. Although we now meet the electric current everywhere, in telegraph, telephone, electric light and power circuits, as constant current or constant potential, continuous or alternating, high pressure or low pressure, from the feeble telephone current, which has so little power that the combustion of one pound of coal would furnish energy enough to sound the telephone for over 1,000,000 years, up to Deptford's 10,000 volt alternate current, which counts by many thousands of horsepowers, or to currents of many thousands of amperes, which weld thick iron bars together; nevertheless, quite a number of electricians remember distinctly the time when our electrical knowledge was a great chaos; when the terms amperes, ohms and volts —now commonplace amongst the workmen of our factories—were not yet invented. The first series wound dynamos were measured by "Groves," or "Daniels," instruments recommended as being "able to measure even such powerful currents as are used for the production of carbon light," and a vague term, "projectile force," used to explain why a number of cells in series, although not giving "more current" than a single cell, could ring a bell through a long wire, which a single cell was not able to do.

Ohm's law, $C=\frac{E}{R}$, discovered a long time before, found its practical application as the fundamental law of electrical engineering by the introduction of the electrical terms, amperes, volts and ohms, by the International Congress of Electricians at Paris in 1881.

Kirchhoff's laws of electric current distribution and the law of the conservation of energy cleared the path of progress in the electrical arts; and the "practical electrician," that is, the man of "large practical experience," with a slight knowledge of the formulæ used for the calculations of dynamos—so far as they are found in text-books —went to the other extreme, and soon

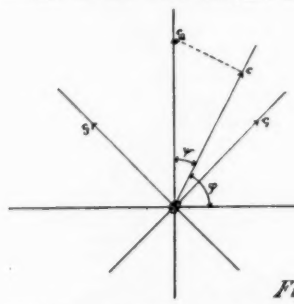


Fig. 1

trusted these formulæ so sincerely that he could not even imagine conditions where Ohm's law and the other laws of electric current distribution, to wit:

1. That the sum of all the currents flowing toward a distributing point is equal to the sum of the currents flowing away from this point, or, in other words, that the sum of all the branch currents equals the undivided current.

2. That the sum of E. M. F.'s acting between two points of an electric conductor (including the E. M. F. consumed by overcoming the electric resistance of this conductor and thereby converted into heat) equals the potential difference between these points, so that in a closed circuit the sum of all the E. M. F.'s (including the heating E. M. F.) always equals zero, or, in other words, that the parts of an E. M. F., added together, are equal to the whole, etc., did not hold.

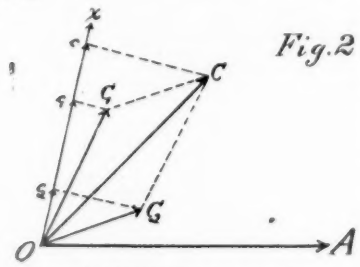


Fig. 2

Only one phenomenon was not fully explained by these laws—the phenomenon of *self-induction*, or, as it was called, the "extra current." But it was still of rather little importance, and caused disagreeable surprise only occasionally, when by suddenly breaking the circuit of a series dynamo it punctured the insulation and burned out the armature. Then the electrical engineer found consolation in the steam engineer, who told him that he was not allowed either to stop or start a big engine suddenly, but had to do it slowly, because of the momentum.

Then the alternate current, aided by the converter or transformer, tried to regain its former position in the field of electrical engineering, which it was obliged to give up some years before, because of not being able at that time to fulfill the conditions of electric current distribution.

While the opinions on the practicability or impracticability of alternate current distribution were still divided, alternate current central stations sprung up everywhere, in city and country, and soon the fight between continuous current and alternate current engineers was brought to an end by the practical proof of the ability of the alternate system to fulfill the conditions of current distribution, and the acknowledgment of its

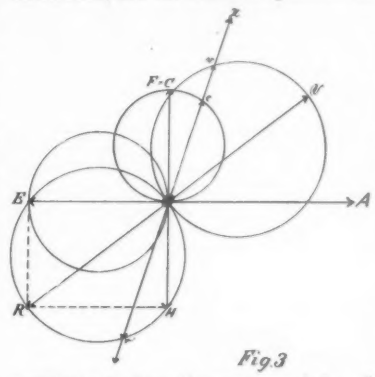


Fig. 3

superiority for long distance transmission of electric energy.

From the first, Ohm's law and the other laws of continuous current distribution held their usual place even in alternate lighting circuits, and were generally found to give fair results.

But by and by, as the conditions became more manifold, as choking coils were introduced into alternate current circuits, or lead and iron-armored cables used, the deviations from Ohm's law became more marked, so that at last anybody could see that for alternating currents—so far as the "effective current" is concerned—Ohm's law does not hold. Certainly it does not when through a wire coil of half an ohm resistance, under a pressure of 100 volts, perhaps 20 amperes were found to pass, instead of the 200 amperes which we had to expect from Ohm's law. Hence, the phenomenon of self-induction became important in electrical engineering.

That did not introduce many difficulties at first; instead of the true ohmic resistance, we had to use a kind of "spurious resistance," or "impedance." Write instead of R:

$$\sqrt{R^2+(2\pi S N)^2},$$

where N is the number of periods of the alternate current per second, and S the "co-efficient of self-induction" of the circuit.

Then the current is given by:

$$C=\frac{E}{\sqrt{R^2+(2\pi S N)^2}}.$$

The co-efficient of self-induction, S, is easily determined by experiment, by sending an alternate current through the circuit, measuring C, E, R, computing N from the counted number of revolutions of the alternator, and therefrom deriving S, as a constant of the circuit.

Still the current was proportional to the E. M. F., so that by increasing or decreasing the E. M. F., E, the current, C, increased or decreased proportionally. That is, the impedance,

$$\sqrt{R^2+(2\pi S N)^2},$$

is a constant of the circuit.

Indeed, the well trusted laws of electric current division sometimes refused to hold for alternate currents. When dividing a current into branches, the sum of the branch currents was larger than the undivided current, and we were able, for instance, to divide a current of 13 amperes effective into two branches of eight and of nine amperes, or to take off from an alternator, which was feeding a lighting circuit with 20 amperes, two or three amperes by a separate circuit. Nevertheless, the alternator gave not perceptibly more than 20 amperes. Or we put into a 50 volt light circuit a lamp dimmer, which consumed 30 volts, and still 35 volts were left for the lamps!

Still more complicated phenomena were found where magnetism was expected from alternating currents, and a greater amount of iron was introduced into an alternating coil. The resistance of the coil was very small. But a pressure of 25 volts applied to it forced only two-thirds of an ampere through it. Now we increase the pressure to twice its former value, to 50 volts, and expect to see twice as much current, that is, one and one-third ampere, pass. But we find only one ampere; that is, less than was expected. Doubling the pressure again, to 100 volts, suddenly the coil acts like a short circuit, and 15 amperes pass (actually observed values). By doubling the E. M. F. the current has increased 15 fold, and before by doubling the E. M. F. only by 50 per cent.!

So in an ironclad impedance, the current ceases to be proportional to the E. M. F.; the spurious resistance and the coefficient of self-induction are not constant, but depend upon the voltage, and the last law has gone.

Hence, when dealing with alternating currents in inductive circuits, we have to give up all the well trusted laws of continuous current distribution and division, and start anew, to understand, and thus to calculate the phenomena which we have to encounter.

Generally, the alternate current and the alternate potential is considered and treated as a true harmonic or sine wave. And in reality, the currents of our modern alternators are so near sine waves that this assumption can be accepted almost everywhere. Only varying resistance, as in arc lights, and hysteresis in iron-clad electromagnets of heavy self-induction, are liable to somewhat change the shape of the electric wave. But even then the sine wave generally gives very fair approximations.

The sine wave is represented in rectangular co-ordinates by the well known wave line. But this representation has the great disadvantage that it is not suitable to be used for further graphical calculations. Besides, it is a curve which cannot be drawn by rule and compass, but must be plotted, and the curve rules usually being shaped after conic sections, generally do not fit the sine wave form.

I have found the *polar diagram* of much more convenience and ease for graphical calculations of alternate current phenomena. Not that diagram as it is used by Kapp, Blakesley and others, where the instantaneous values of the electric wave are represented by the projections of a revolving line upon that radius which represents the time of the maximum value of the electric wave, while the length of the revolving line represents this maximum value, and one revolution corresponds to one complete period, but the true polar diagram, where the angle represents the time, 360°=2π, corresponding to a complete period, and the radius vector represents the instantaneous value of the electric quantity.

Let the time, t, be counted from that moment where the current, c=0.

Let C= the maximum current.

Let T= the time of one complete period.

Then the instantaneous value of the current at the time t is given by the equation:

$$c=C\sin\frac{2\pi t}{T}=C\sin\varphi$$

where the angle $\varphi=\frac{2\pi t}{T}$; that is, $2\pi=360°$, corresponds to the time T of one complete period, as supposed.

the center 0, and thereby gives again the point c_1.

At the angle $\varphi=270°$, the current is $c_3=-C$, and thereby gives again the point c_3.

At the angle $\varphi=315°$, the current is $c_4=C\frac{1}{2}\sqrt{2}$, and thereby gives again point c_4.

At the angle $\varphi=360°$, the current is again=0.

In general, at the angle φ, the current is $c=C\sin\varphi$.

Hence, connecting c with $c_2=C$, it is (Fig. 1.)

$$Oc=OC\cos\psi,$$

but it is: $Oc=OC\sin\varphi$.

Hence: $\angle)\ \varphi+\psi=90°$, or,

all the points, c, c_1, c_2, c_3, lie upon a *circle* with the maximum value, $Oc_2=OC$, as diameter, or,

"In the polar diagram, the sine wave is represented by a circle, that is, an elementary curve, which has the maximum value of the wave as its diameter, and is produced twice during each period of the alternate current."

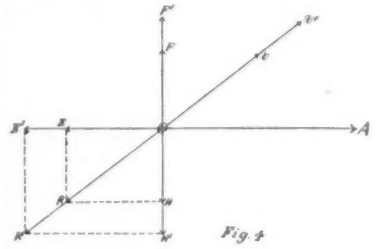


Fig. 4

In the same way, alternate E. M. F.'s, M. M. F.'s, etc., are represented by *circles*, which are determined by phase and size of their maximum values as diameters.

Now, suppose we have two sine waves of different strength and different phase, combining with each other. They may be represented in Fig. 2 by the length, OC_1 and OC_2, as their maximum values, or as the diameters of their polar circles.

Then at any time t, represented by the angle $\varphi=AO\psi$, the instantaneous values of these waves are Oc_1 and Oc_2.

Combine the two lines, OC_1 and OC_2 by the parallelogram law to the line OC, as the diagonal of the parallelogram OC_1CC_2, which has the component waves OC_1 and OC_2, as sides.

Then the instantaneous value of the resulting wave OC at the time t is Oc.

But because $Oc_1=c_2c$, $Oc=Oc_1+Oc_2$.

Hence,

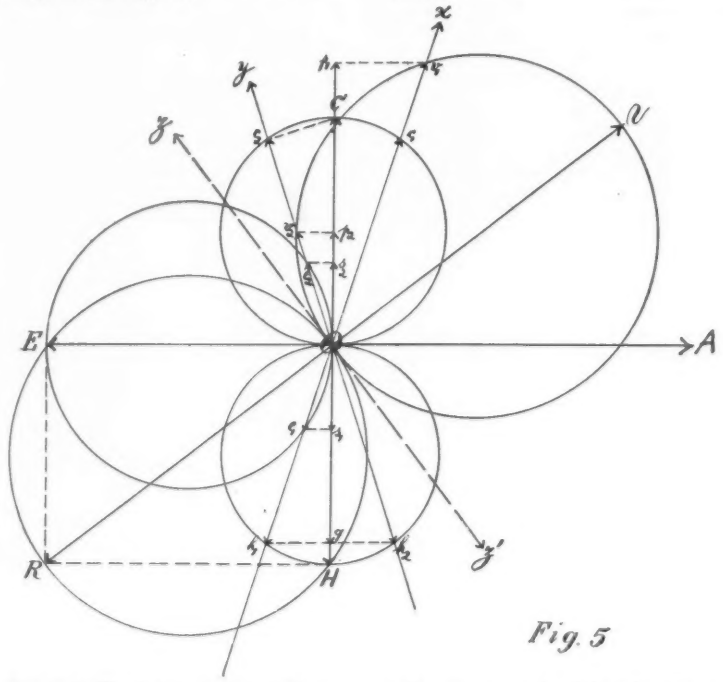


Fig. 5

Choose, in Fig. 1, OA as the zero line.

At this time t=0, the current is c=0.

(The *instantaneous* values of the electric quantities are represented by *small* letters, their *maximum* values by *capitals*.)

At the angle $\varphi=45°$, the current is $c_1=C\frac{1}{2}\sqrt{2}$, cut out on the radius by the length Oc_1.

At the angle $\varphi=90°$, the current is $c_2=C$, cut out on the radius by the length Oc_2.

At the angle $\varphi=135°$, the current is $c_3=C\frac{1}{2}\sqrt{2}$, cut out on the radius by the length Oc_3.

At the angle $\varphi=180°$, the current is again =0.

At the angle $\varphi=225°$, the current is $c_4=-C\frac{1}{2}\sqrt{2}$; therefore, it has to be represented on the prolongation of the radius vector over

"Two sine waves in their polar diagram represented in length and phase by two lines, OC_1 and OC_2, combine to one resulting wave, OC, by the law of the parallelogram."

That is,

"Two alternate currents, E. M. F.'s, M. M. F.'s, etc., combine to a resulting current, etc., which in the polar diagrams of alternating waves is the diagonal of the parallelogram, which has the component waves as its sides."

Therefrom we see that the resulting current OC is smaller than the sum of the component currents OC_1+OC_2.

For instance, if the difference of phase between both currents $\angle)\ C_1OC_2=\delta=80.6°$, and current $C_1=9$ amperes, $C_2=8$ amperes the resulting current C=13 amperes, and we have a current of 13 amperes divided into two branch currents of 8 and of 9 amperes!

Therefrom follows:

"More than two sine waves combine by the

(Continued on page 232.)

Some Notes on Electrolytic Quantitative Separation of Metals.

BY T. O'CONNOR SLOANE, PH. D., IN THE JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.

It may seem somewhat presumptuous after Classen's classic work in electrolytic analysis, to offer any suggestions as to the conducting of this class of quantitative determinations. But there is one point in the work which it may safely be said has been to a certain extent neglected. This point is the influence of electromotive force, or of difference of potential, upon the separations.

In Classen's work upon the subject the voltage of the circuit is duly considered, and an elaborate rheostat for regulating the voltage within somewhat crude limits (½ volt) is described. This is in one of the introductory chapters. The rheostat is for use with a 600 watt dynamo. But the author also mentions batteries and describes his method of conducting determinations with these sources of electromotive force. The current strength is then the standard, and it is determined by the volume of oxyhydrogen gas which the current can liberate in a definite time. In other words, the amperage of the current alone receives direct attention. By using the same sized electrodes, the author states, the conditions are kept sensibly the same. Here we have an indirect recognition of the influence of electromotive force. But the attempted maintenance of the most uniform conditions is a poor reliance. The conditions will inevitably vary and the temperature of the room and gradual change of the nature of the solution operated on will cause variations in resistance that will affect the difference of potential. To show how little regard is paid to voltage, we are directed in iron determinations to use two and sometimes three Bunsen cells. Any change in the number of cells in series would cause great variations in the voltage, in the case cited about 50 per cent. If the cells were kept in parallel and any resistance, such as that of a voltmeter, were in series with the decomposing apparatus, a great variation in voltage would even then ensue by changes in the number of cells.

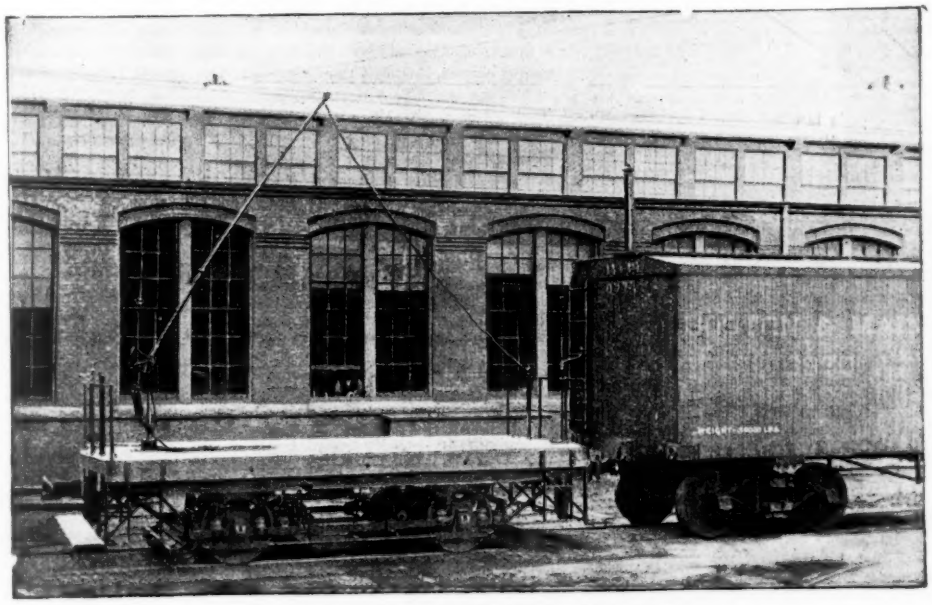
The object of these notes is to plead for a greater recognition of the influence of difference of electric potential in analytical work. The facts of the case are these: For the decomposition of every solution a definite and absolutely fixed voltage is required. The strength of current affects only the condition of the deposit. Thus a current of any number of amperes might be passed through acidulated water without decomposing it until the voltage passed a fixed point when decomposition would at once begin. A single gravity cell, large or small (sulphate of copper-zinc-copper couple) cannot decompose water because its voltage is too low. The minutest bichromate cell will at once begin to decompose it because its voltage is high enough.

Again, the amperage of the current should not be broadly stated without reference to absolutely fixed conditions of electrodes. The proper way would be to state it as referred to unit area of cathode and anode. Probably the cathode reference would be all that is needed. As ordinarily put, the cathode is supposed to be a platinum dish of more or less definite size, filled with a variable depth of fluid, and the electrolytic gas set free in one or more minutes is given. All this tells nothing.

It would seem obvious that, a definite and absolutely fixed difference of potential being required for the decomposition of each compound, the voltage could be made the basis for analytical work. It would be possible to effect successive separation of metals from the same solution by modifying the voltage, starting, of course, with the lowest. How far the precipitation of mixed metals, so-called alloys, would interfere with such attempts is not definitely recorded. It amounts to nothing to state, as is done, that a weaker current than is required for iron, or some other metals, will precipitate copper. The strength of the current has nothing to do with it. It is the difference of potential that affects the result. The varying of such difference corresponding in a general way with the strength of the current, as the operations were conducted, has doubtless occasioned the confusion.

In stating the results of or giving directions for conducting electrolytic separations, two factors should always be stated. One is the difference of potential, the other the amperage per unit area of cathode. Then something definite would be known. It seems probable that by working on these lines, some exceedingly interesting results in the way of double decompositions, as well as of separations, might be obtained.

Should any such result be obtained as the determining of a series of potential differences available for separations of metals from single solutions, it would be highly interesting. The heat of combination of a vast number of compounds has been obtained and is readily reduced to volts, but such reduction is theoretical and does not accurately hold for all cases. The principal trouble would lie in the regulation of the voltage. But at the least there seems ground for research in the direction here suggested.



THOMSON-HOUSTON ELECTRIC FREIGHT LOCOMOTIVE.

An Electric Freight Locomotive.

The subject of the illustration on this page is one of the largest freight locomotives which has been constructed to operate by means of electricity. It was built by the Thomson-Houston Motor Company, of Boston, and is now in use at the cotton mills of the Lonsdale Company, at Lonsdale, R. I. The locomotive consists of a platform car and truck equipped with a 30 horse-power Thomson-Houston motor. It is provided with a trolley stand and trolley at one end, and at each end with a controller stand by means of which the speed of the locomotive can be governed and its direction changed when necessary. The locomotive is capable of hauling a load of 60,000 pounds at the rate of five miles an hour. In addition to its use for haulage purposes, the locomotive platform, which measures 8 × 18 feet, may be loaded with material which it is desired to transport from place to place.

The total length of track over which the locomotive is used is 2,700 feet, on which the single trolley overhead system has been used, the wire being suspended over the center of the track by means of brackets fastened to the buildings where possible and to poles. The conductor varies between 16 and 18 feet in height from the ground. The necessary electric current for the operation of this tramway is obtained from a 500 volt Thomson-Houston dynamo of 30,000 watts capacity, which is driven from one of the water wheels which furnish power for the mill machinery.

PERSONAL.

Mr. Thomas Lowrey, the Minneapolis electric railway magnate, visited New York last week, stopping at the Fifth Avenue Hotel.

Capt. W. L. Candee and wife sail for London July 1st, to be absent two months in that city and on the continent of Europe.

M. Geo. F. Card, formerly of Cincinnati, has been made manager of the mining department of the Fort Wayne Electric Company.

Mr. C. O. Baker, Jr., the distinguished platinum refiner, left this week for the Pacific Coast, to spend several weeks in pleasant travel.

Mr. H. B. Cram, the enterprising and genial head of the Bernstein Electric Company, of Boston, paid several of his New York friends a welcome visit recently.

Messrs. C. R. Huntley and E. F. Peck, of the National Electric Light Association, are reported to have proven themselves orators of no mean ability at a recent meeting with Montreal officials. The electrical man can generally be depended upon.

Prof. James J. Wood, the well known inventor and electrician, was a New York visitor last week. Professor Wood is now living at Fort Wayne, Ind., devoting his time and talents to the electrical interests of the progressive Fort Wayne Electric Company.

Messrs. O. E. Madden, E. T. Gilliland, and a few other electrical men have recently become the owners of a five acre island near the Long Island coast. This island is a mile and a half distant from any other land and is a quiet and cool retreat that is particularly inviting to the fevered brows of hardworking electrical artists.

Mr. Charles Dutton, of the Southern Bell Telephone Company, and a very active member of the Electric Club, is the possessor of a beautiful collection of etchings which adorn his Orange residence. One of these etchings, through the kindness of Mr. Dutton, has found its way to a certain editor's sanctum, where it is seen and admired every day.

Mr. P. C. Ackerman, New York representative of the American Electrical Works, of Providence, recently returned from a very successful trip to the Pacific coast. The electrical business, though quiet in some cities was active in others, enough so to give Mr. Ackerman the pleasure of booking a number of good orders for the high grade insulated wire of his company.

Mr. W. D. Sargent, the able and classical telephonist of Brooklyn, takes a particular pride in his beautiful city, and recently entertained a few electrical globe trotters at the Montauk Club, on Prospect Heights. The distinguished guests were highly entertained and discovered beauties in the city of churches that as New Yorkers with a Paris leaning they never imagined existed.

Elwood, Ind.—Elwood Electric Light and Power Company; capital, $10,000.

Battle Creek, Mich.—Battle Creek Electric Railway Company; capital, $100,000.

Sacramento, Cal.—The Vallejo Electric Light and Power Company; capital, $10,000.

Catlettsburg, Ky.—The Catlettsburg and Pikeville Telegraph Company; capital, $10,000.

Butte, Mont.—Rocky Mountain Electrical Power and Supply Company; capital, $50,000.

Warren, O.—The Trumbull Electric Railroad Company, Warren and Niles; capital, $150,000.

Davenport, Ia.—The Davenport Electric Railway, Light and Power Company; capital, $300,000.

Spokane Falls, Wash.—Granite Lake Transit, Land and Improvement Company; capital, $250,000.

Lansing, Mich.—The Jefferson Avenue Electric Railway Company; capital, $100,000. Incorporated by Cameron Currie, and others.

Graniteville, S. C.—Cotton Shoals Electric Light and Power Company; capital, $10,000. Directors, Alvin Etheridge and W. G. Edwards.

Ashtabula, Ohio.—The Ashtabula Rapid Transit Company, to construct a street railway and an electric light and power plant; capital, $150,000.

Minneapolis, Minn.—The Standard Electric Company; capital, $10,000. The incorporators are, George C. Smith, W. J. Reno and John M. Lemon.

Chicago, Ill.—Winters Electric Company; capital, $10,000; to manufacture electric appliances. Incorporators, F. M. Winters, A. F. Raymer, A. H. Baldwin.

Greenwich, N. Y.—Greenwich Electric Light and Power Company; capital, $15,000. Directors, Henry Gray, Le Roy Thompson, John Brooks, James O. La Vake and George A. Packer.

St. Louis, Mo.—Citizens' Electric Light and Power Company; capital, $750,000. Incorporators, Emil A. Mysenburg, Benjamin Von Phul, Robert L. McLaran and A. J. Cooper.

Knoxville, Tenn.—A stock company, to be known as the Seven Cities Telephone and Telegraph Company, is being formed to connect Cowan City, Tazewell, Arthur, Hamilton Springs, Cumberland Gap, Harrogate and Shawnee.

Chicago, Ill.—United States Electric Company, to deal in electrical inventions and patent rights therefor, manufacture and sell electrical machines, etc.; capital, $10,000,000. Incorporators, Robert J. McIntyre, James B. Keogh and Robert B. Kendall.

St. Paul, Minn.—The Kent Electric Writing Machine Company; capital, $500,000. The incorporators are D. H. Kent, St. Paul Park; A. S. Morton, A. T. Hall and J. Warwick, of St. Paul, and Benjamin Davenport, of Minneapolis. The officers are D. H. Kent, president; Benjamin Davenport, vice-president; J. Warwick, secretary; A. S. Morton, treasurer.

LITERARY.

"Journal of the Institution of Electrical Engineers" for May, 1891, has been received.

"Bulletin de la Société Internationale des Electriciens," for May, 1891, has been received.

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Electrical matters in the courts are making things particularly lively just now, and there is promise of more to come.

Again pops up a carbon trust. This makes No. 3. If no more successful than former ones, this trust will not be long on earth.

The progressive spirit shown by the Detroit Electrical Works is truly exhilarating in these dull Summer months. May this be the forerunner of many such enterprises.

An English journal, sailing under the name of *Electricity*, has done us the honor to reproduce, without credit, our article and illustration of the Eastern Electrical Manufacturing Company's telephone switchboard, which appeared in the ELECTRICAL REVIEW for May 16, 1891. We would suggest that the article would have been more valuable to our English electrical friends had they known its original source.

The details of the outrage perpetrated upon Prof. W. W. Jacques and his daughter by a mob of Italian ruffians are given in this issue of the REVIEW. Professor Jacques' account indicates that the affair is worthy the attention of our State Department, which should see that the offenders are properly punished. Professor Jacques is to be congratulated that the affair was no worse.

Municipal electric lighting plants may now be established in Massachusetts by cities only after the approval of two-thirds of each branch of the city council, the assent of the mayor for two consecutive years, and the ratification of the majority of the voters at an annual election. In the case of towns there must be a favorable vote of not less than two-thirds of the voters present at each of two legal town meetings duly called for the purpose, of which meetings the second shall be held at an interval of not less than two or more than 18 months after the first. If these conditions do not prevent the building of municipal plants, the expensive experience of running them by politician power will at least be a source of regret.

"The electric railroad from the new Thirty-ninth street, Brooklyn, ferry to Bensonhurst is now completed. The cars are the handsomest ever constructed." This we read in a New York paper and it gives us pleasure to see such a sign of the times. We utterly fail to see the cause of the opposition to the projected electric line in Brooklyn, unless it is that as electric railroads chiefly benefit the poorer classes, the rich man who can drive in his own carriage takes up arms against them from pure selfishness. The worker wants low rent and he can only find it at a distance from his work. To get to and fro he must call either steam or electricity to his aid—horses are too slow. Electricity can go where steam cannot, but the rich man bars the way. There has been more nonsense written about the trolley wire than about any other electric wire in use to day, and that is saying a good deal. Nobody will welcome the introduction of an economical and efficient storage battery or underground conduit system of electric traction more than we shall, but until something of that sort comes along the trolley system should have its way. It seems passing strange that while it has been so successfully and largely employed in other sections of the country, such an amount of stupidly ignorant opposition should be brought to bear against its introduction in the immediate vicinity of the electrical center of the United States.

RAPID TRANSIT IN THE DAILY PRESS.

The Philadelphia *Press* says that "New York opinion is steadily tending towards underground rapid transit. Now that tunnels can be dug cheaply and roads run by electricity without smoke or dust, there is no reasonable doubt that in 10 or 20 years the elevated railroad will be looked on as a barbarous use of streets." The elevated railroads are looked on by many as a barbarous use of streets to-day, but, unfortunately, in New York they are a necessity, although we doubt whether they will be considered so 20 years hence. Curiously enough, the New York *Sun* has taken a stand in favor of the elevated roads, and derides the underground rapid transit scheme. As regards the cost of tunneling in New York city, it will, no doubt, come pretty high in some parts of the town, and unquestionably there are people who will object to traveling in a tunnel, even though the atmosphere be pure and cool and the rate of speed rapid.

But when the *Sun* gives its opinion on electric motors and their capabilities, then it certainly ventures out of its depth and displays both ignorance and prejudice. The *Sun* questions whether it is possible for an electric motor to draw even one loaded passenger car at the rate of 30 miles an hour, or even of 20 miles an hour, and doubts whether such a motor can be constructed. As a matter of fact, the lower speed is frequently attained on several electric railroads in this country, and in London electric motors are now drawing trains of three "loaded passenger cars" at a speed of 20 miles an hour, and have been doing so every day for months past. There are several electrical engineering firms in this country who would cheerfully accept contracts to-morrow to construct electric motors capable of doing all that the *Sun* professes to be in doubt of.

UNDERGROUND TELEPHONE CABLES.

Our London namesake, in the latest issue to hand, that for May 29, comments on an article on paper insulation for telephone cables which was recently published in our columns. The results which we stated had been achieved, namely, that with practically the same number of conductors, thickness of insulation and diameter of lead pipe, improvements in manufacture had taken place to such an extent that within a few years the average inductive capacity of the conductors has been reduced from .22 mfd. per mile to within the neighborhood of .085 mfd. per mile, are naturally received with some surprise, bordering, in fact, almost on incredulity.

We can readily understand that the *Review* should look somewhat askance at the figures which we presented, not only because they really are somewhat startling in themselves, but also because in England very little experience has been had with underground telephone cables. Where they have been employed we believe that rubber has generally been used for the dielectric, and the capacity is, of course, very high.

In this country, however, underground work has become a necessity, and almost all the large telephone companies have a considerable length of underground cable in use. In New York city alone there are over 200 miles of 100-conductor underground telephone cable, and at the present time a telephone circuit could be made from the Battery to the Harlem River entirely through underground cables. For several years it has been the constant aim of the technical officers of the telephone companies, and of the cable manufacturers who compete with each other, to improve the electrical conditions of the special type of cable used for telephone work—in other words, to reduce the inductive capacity.

Up to quite recently the insulating material employed was generally some fibrous covering, such as cotton, hemp or paper, surrounding the conductors themselves, the core, composed of the group of insulated conductors laid up together, being treated with some insulating material such as paraffine or resin oil, or a compound of oil and other insulating substances. A cable of this class containing 100 conductors (No. 18 B. & S. guage), each insulated to .125 of an inch, enclosed in a pipe of 1.75 inches internal diameter, had a capacity of about .18 mfd. per mile, very much lower, of course, than rubber would give, but still not low enough to suit the telephone man.

By small improvements in the process of manufacture this capacity was still further reduced by about two or three one-hundredths of a microfarad, but the great gain has been made by abolishing the filling of paraffine or compound and thus obtaining a dielectric of cotton or paper and air only. The insulation resistance of the cable is by no means impaired, if anything it is improved, and in any case it is always far above the requirements. If anything happens to the lead pipe repairs must be made, because the insulation will fail whether the dielectric is paper and compound or paper and air; therefore, as far as insulation is concerned, the cable is just as well off without the compound as with it. But, of course, a great reduction is effected in the capacity, as the spaces which were previously occupied by compound are now filled with air, which has the lowest specific inductive capacity of any dielectric known. Given a little American ingenuity in arranging the paper covering on the conductors so as to obtain the maximum amount of air space with the minimum of paper necessary to keep the conductors properly separated, and our contemporary will readily see that the combination permits of securing a cable having a very low inductive capacity.

There is no doubt in our mind that the most important improvements made in telephone work of late years are embodied in the production of a very highly developed type of underground telephone cable.

A most able and interesting article on "The Polar Diagram of Alternate Currents," from the scientific pen of Mr. Charles Steinmetz, of Yonkers, N. Y., appears in this issue of the REVIEW.

CORRESPONDENCE.

OUR BOSTON LETTER.

Mr. D. A. Andrews, Jr., of the Pettingell-Andrews Company, this city, has left business responsibilities behind him and hied himself to the mountains for a month's recreation.

Mr. H. M. Whitney, president of the West End Railway Company, of this city, stated recently that "the electric lines of the West End system have increased the value of suburban real estate from 30 to 50 per cent."

The Shipman Engine Company, this city, has enlarged its working force and increased its manufacturing facilities to meet the increasing demand for its meritorious product. The company has just filled orders for an isolated electric light plant in Callao, Peru, S. A., and Melbourne, Australia, respectively.

The Pettingell-Andrews Company, this city, has declared a quarterly dividend of two per cent., payable July 1. This company has issued a circular to the electrical trade announcing that it has purchased the entire business of the Standard Electric Supply Company, formerly at No. 180 Summer street, this city.

Boston Electric Club.—At a special meeting of the board of directors, June 8, an executive committee was appointed as follows: Messrs. John C. Wilson, L. S. Dumoulin, A. C. Shaw, Frank Ridlon and R. F. Ross. A special meeting of the Club has been called, to be held at the Club rooms, Monday evening, June 15.

Another Electric Enterprise.—It is rumored that "a new electrical industry will soon be inaugurated at Concord, N. H., for the purpose of manufacturing dynamos, railway motors and storage batteries, under the patents of Mr. J. H. Showhan, of Detroit, Mich." It is also stated that "local capitalists have already subscribed liberally to the new enterprise."

Messrs. Pinkham & Godfrey, electrical engineers and contractors, have established themselves in comfortable quarters at No. 38 Bedford street, this city. These clever electrical experts have been identified with several electric industries in this section during the past three years, and are thoroughly experienced in all that is necessary to give perfect satisfaction in whatever they may undertake in their line.

Beattie Zincs for electric batteries are highly commended by Superintendent Drake of the Trenton, N. J., police and fire alarm telegraph systems. Mr. Drake states in his unsolicited testimonial that "the Beattie zincs are more powerful and durable for police signaling or fire alarm service than any other zincs I have tried." The Beattie Zinc Manufacturing Company has an office at No. 48 Congress street, this city.

Boston, June 13, 1891. W. I. B.

OUR CHICAGO LETTER.

Mr. George F. Card, of the Fort Wayne Electric Company, was in the city this week.

Mr. Frank H. Putney, president Waukesha Electric Light Company, paid Chicago a flying visit this week.

Mr. Clarence A. Ross, representing the Thomson-Houston Electric Company, spent a day in Chicago this week.

Mr. W. H. McKinlock, president of the Central Electric Company, has just returned from a short business trip.

Mr. George C. Davis, of the Interior Conduit and Insulation Company, who has been in this city for some days, returned to New York this week.

Mr. E. R. Gilman, of the Great Western Electric Company and president of the North Western Thomson-Houston Company, has gone East on an extended business trip.

George Cutter is at present out of the city on a short business trip. Mr. Cutter's shops are now working to their full capacity turning out the many specialties manufactured by him.

Mr. Fisher, manager of the Mosher Arc Lamp Co., has just returned to the city after an absence of 10 days. He reports some large sales of these lamps which are giving excellent satisfaction and are becoming very popular.

Frank Bateman & Company, 437 The Rookery, have been appointed selling agents for the well-known Jones Nut-Lock. This is an ingenious little device, and is positive in its action, preventing any turning whatever of the nuts wherever used. They issue a neat descriptive catalogue.

Mr. P. Pfatischer and Mr. C. Register, of the Accumulator Company, passed through this city *en route* to Philadelphia. Mr. Register has been in Dubuque, Iowa, in charge of the Edco storage battery car, which has been in operation there for some months. Mr. Pfatischer went to Dubuque about the 1st of May to superintend the equipping and starting of the new storage battery cars purchased by the Dubuque Street Railway Company. They have completed their task and are returning home, leaving the first thoroughly equipped storage battery road in the country working admirably. The citizens are loud in their praise of the system. L. W. C.

Chicago, June 13, 1891.

OUR ALBANY LETTER.

It is Rumored that a Brooklyn firm, engaged in the manufacture of electrical supplies, will soon locate at Matteawan, N. Y.

J. E. Beaupre, who has been employed in the office of the Ticonderoga *Sentinel* for a year and a half, will travel henceforth with an Edison phonograph.

The Associated Press wire to Albany will hereafter be opened in the office of *The Argus*, having been transferred thither from the editorial rooms of the *Express*.

Mr. William H. Cull, who has been for over a year a most efficient manager of the Albany railways electrical interests, has resigned and again been appointed to his old office, electrician of the Hudson River Telephone Company.

A Mortgage for $150,000, executed by the Hoosick Falls Water, Power and Light Company to the Holland Trust Company, of New York, has been recorded in the county clerk's office at Troy. The instrument was executed May 4, 1891.

Representatives of the Pruyn Manufacturing Company met recently at Troy, N. Y., to inspect the new electrical devices for the purpose of manufacturing which the company was organized. The meeting was held at the office of the Troy Dynamo and Electrical Supply Company. The electrical machines under inspection were the inventions of Mr. Charles F. Winkler, of Troy, N. Y. Mr. Winkler has invented a storage battery, motor and dynamo, all of which are clever bits of work and will probably create quite a stir in the electrical world.

Albany, June 13. L. M. W.

NEW YORK NEWSPAPER MEN.

Col. John A. Cockerill is now the editor of the *Morning Advertiser*. The Colonel enters the journalistic clover field through a gate that leads to good browsing—a one-cent, four-page daily. There is room for such a journal here, and Colonel Cockerill's *Advertiser* already ably fills it.

The *Recorder* announces with pleasant self-congratulation that it has secured the exclusive services of Mr. Joseph Howard, Jr, whose 30 years of constant work in metropolitan journalism have only served to make his writings brighter, keener, more virile and more aggressive than at any previous time in his career. It is impossible that any individual should know everybody and everything in New York, but Mr. Howard approximates that vastness more nearly than any other man, and the *Recorder* is to profit by his accumulated knowledge and experience.—*New York Recorder.*

Former City Editor Fleming is managing editor of the *Mail and Express* during the absence of Foster Coates in Europe. Mr. Coates is writing very interesting letters from London.

Mr. Arthur Brisbane is the author of an entertaining article in the *Journalist*, describing Mr. Charles A. Dana as he appears in his daily work. This most distinguished editor is evidently a true philosopher, and from Mr. Brisbane's point of view is engaged chiefly in finding out what he doesn't know and enjoying everything in life, particularly his work as editor of the New York *Sun*.

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire & Co., Electrical Securities, 18 Wall street, N. Y., Saturday, June 13, 1891. New York, Boston and Washington Stock Exchanges.

NEW YORK.	
Western Union Telegraph Co	80½
American Telegraph & Cable	
Central and South American	135
Mexican	200
Commercial Cable Co	105
Postal Telegraph Cable	80
Edison General Electric Co	99
" " Deferred	
Consolidated Electric Light	
Edison Electric Illuminating Co	76
United States Electric Light	30
North American Phonograph	
BOSTON.	
Thomson-Houston Electric Co	42⅝
" " " Preferred	25
" " " Series C	
" " " Series D	7
" " International Co	
" Welding Co	
" European Welding Co	
Ft. Wayne Electric Co	12
Westinghouse Electric Mfg. Co	12⅞
Detroit Electrical Works	
TELEPHONE:	
American Bell	198
Erie	48
New England	50
Mexican	1.25
Tropical American	.90
MISCELLANEOUS:	
Edison Phonograph Doll	.50
WASHINGTON.	
Pennsylvania Telephone	24
Chesapeake and Potomac	62
American Graphophone	5¾
United States Electric Light (Wash'ton)	155
Eckington and Soldiers' Home Electric Railway	49½
Georgetown and Tennallytown	57

The Montreal Convention.

The Executive Committee and the Committee on Exhibits of the National Electric Light Association met at the Windsor Hotel in Montreal, on the 8th inst., to arrange the details of the coming convention and exhibition, to be held in that city in September next. These committees received a most enthusiastic and cordial welcome from the Mayor and representatives of the Common Council and also from a deputation from the citizens' committee, organized in Montreal for the purpose of carrying out the plans for the reception and entertainment of the Association during the Convention. Mayor McShane and Alderman Stevenson represented the city government, and ex-Mayor Beaugrand, the French-Canadian population.

The Mayor said that as Mayor of Montreal he would be very glad to welcome the Association in September, and assured them of a hearty welcome from the citizens. Col. Stevenson thought September a good time for the Association's visit, as citizens would have returned from the country and the city would be looking its best. He was sure the Association would be accorded a hearty welcome.

Mr. Beaugrand said the French-Canadian element would welcome the Association. He was aware that electricity was much more extensively adopted in the States than it was here in Canada, but felt sure the proposed visit of the National Electric Light Association would awaken interest and enthusiasm in the subject. He spoke of the royal welcome accorded to Mr. Edison at Paris, of which he was an eye-witness, and said that men of intellect were honored in Europe as well as men who could trace their pedigrees backwards for centuries. The Association would be received as representing the energy, intellect and enterprise of the United States. Mr. Huntley, the Association's president, in reply, said that he thought the fraternal feeling between the two countries should be fostered and the meeting was a step in the right direction. He highly praised the beauty of Montreal and its environments.

The executive committee for the reception of the Association was represented by Professors Bovey and Cox, of McGill University, and Mr. John Carroll, of Montreal. Professor Cox, as secretary, read the report of his committee, which was as follows:

The committee has held three meetings. A reception committee is being formed which already includes a large number of the most influential citizens of Montreal.

His Excellency, the Governor-General, has signified by letter that if the visit of the association takes place in September, he hopes to be present, but under any circumstances will be glad to give his patronage to the meeting.

A number of plans for offering entertainment to the Association have been considered, but the final adoption must depend upon the date adopted for the visit, and the programme of the Association. Among the suggestions already considered by the committee are plans for a citizens' ball, lacrosse match, excursion to the rapids, drives around the mountain, promenade concert at Sohmer Park, visits to the G. T. R., C. P. R. and Dominion Bridge Works.

A press committee and ladies' committee will be formed, and special entertainment provided for the ladies of the Association.

The officers of the executive committee, with Mr. John Carroll, were instructed to wait upon the executive of the Association on June 8, and convey to them a cordial welcome to Montreal.

This report was received and adopted with suitable expressions from President Huntley and the members of the executive committee, of their deep appreciation of the hospitable action of the citizens' committee. The meeting then adjourned, and the executive and exhibit committees held a preliminary meeting for the purpose of organization and the discussion of ways and means. The executive committee fixed definitely upon the 7th of September as the opening day for the convention, the exhibition to be held from the 7th to the 16th of September, inclusive.

In the afternoon the party left the Windsor for McGill University, where the technical buildings were visited, especial notice being taken of the electrical department. The visitors were very much pleased to see the large extent of this important faculty and the great interest taken in electricity. From there they proceeded to the residence of ex-Mayor Beaugrand, on Sherbrooke street, who had courteously invited them to partake of some refreshments.

From this point they drove to the city hall, where Mayor McShane received them in a very happy manner.

After a short time spent in the city hall, the party, now augmented by the presence of several aldermen, left the city hall and enjoyed a drive over the city.

In the evening an impromptu dinner was tendered their guests by the citizens' committee in the club room of the Windsor Hotel, the management of which showed themselves equal to the emergency and made arrangements satisfactory to all.

After satisfying the inner man, the customary action of toast drinking was indulged in. Professor Bovey, the chairman, rising, presented the toast of the "Queen," Mr. John Kennedy, A. E., vice-chairman, responding. "The President of the United States" was responded to by Mr. C. R. Huntley, of the National Electric Light Association. "The Citizens of Montreal" was replied to by ex-Mayor Beaugrand, Alderman Villeneuve and Colonel Stevenson. Mr. Beaugrand sustained his reputation for eloquence in a remarkably suitable speech. Speaking on behalf of the citizens of Montreal, he assured the gentlemen present that whenever and however they came to this city they would find the arms of the citizens could not be open wide enough, nor their hearts large enough to show their feelings of hospitality, and assured them that when they came again in September, they would find that the National Electric Light Association would receive such a welcome as they had never received before. Mr. H. H. Fairbanks and Mr. E. F. Peck replied in suitable form, expressing the cordial feelings they held towards Canadians. The toast "McGill College," was replied to by Professor Cox in a very eloquent manner. "The National Electric Light Association" was responded to by Messrs. Gulick and Beane.

On the following day the adjourned meeting of the exhibit committee and also the adjourned meeting of the executive committee were held at the Windsor Hotel. The following named gentlemen were present: C. R. Huntley, president of the National Electric Light Association; F. R. Redpath, of the Redpath Refinery; Professors Bovey and Cox, of McGill University; M. D. Barr, of the Edison Company in Toronto; W. J. Morrison, Fort Wayne Electric Company; Fred. Nicholls, of Toronto Incandescent Electric Light Company; H. H. Fairbanks, of Worcester Electric Light Company; E. F. Peck, Citizens' Electric Illuminating Company, of Brooklyn; J. W. Beane, secretary-treasurer National Electric Light Association; S. C. Stevenson, Council of Arts and Manufactures, Montreal; A. J. Corriveau, Canadian Electrical Construction, Manufacturing and Supply Company, and John Carroll, Eugene Phillips Electrical Works, Montreal. It was decided to hold the exhibition open each day and evening, during which time all the appliances to be in motion and every kind of electrical apparatus and electric specialties to be displayed.

It is expected that this coming exhibition will be undoubtedly the most interesting, also the largest, yet held in the interests of electricity in America, if anything can be judged from the enthusiasm shown by the electrical fraternity and also by all the largest electrical companies, who have already applied for large spaces. From the applications for space already made, it is believed that if the Victoria Skating Rink were twice the size it could be well filled. It is proposed, in anticipation of there being insufficient space, to erect, on the vacant ground adjoining the rink, a large tent which has kindly been offered to the committee by Mr. S. C. Stevenson for the purpose.

A local sub-committee was appointed to co-operate with the chairman of the exhibit committee, J. I. Gulick, for the different arrangements in connection with the exhibition, composed of F. R. Redpath, chairman, Professor Bovey, Professor Cox, Fred. Nicholls, S. C. Stevenson, A. J. Corriveau and John Carroll. At the executive committee's meeting a large amount of important business was transacted, one of the questions discussed being the papers to be read at the convention.

After the business was completed, the party were offered a drive to visit the harbor and fire department under the genial chaperonage of Colonel Stevenson.

The press of Montreal was well represented at the several meetings and entertainments and the local papers most generous in the space devoted to accounts of the events in connection with the same.

Telephonic News

*** The business of the Paris-London telephone line now amounts to about 50 messages per day.

*** The Kinderhook and Hudson Railroad will build a telephone line from Hudson to Niverville, N. Y.

*** A telephone line 100 miles long is being strung upon 1,600 poles between Reading and Columbia, Pa.

*** The Hopkinsville, Ky., Telephone Exchange was sold last week to satisfy an execution. It was bought by a company of citizens and the business will be continued.

*** The American Bell telephone directors, at a recent meeting held in Boston, June 10, declared the regular three per cent. dividend and an extra dividend of six per cent.

*** It is proposed to put telephones in the Janesville, Wis., schools, as parents and teachers are forced to be in almost constant communication since the town has been visited with diphtheria and so many children have died.

*** A deed of trust of the Chesapeake and Potomac Telephone Company to the American Security and Trust Company, of Washington, D. C., was filed last week. It conveys all its lines, purchases, etc., in the District and Maryland to secure the payment of $600,000 worth of bonds issued to extend and improve the facilities for business.

*** The annual report of the directors of the Southern New England Telephone Company to the stockholders shows the receipts for the year to have been $336,467.19 from all sources. The company paid out over $83,000 for rentals and royalties, yet had a revenue balance of over $78,000, showing an increase in the income of over $22,000. The earnings are still applied to the extension of the plant. The new building in Hartford, Conn., has been built and equipped, and an underground system containing 39,758 feet of cable established; this work has cost over $57,000. The monthly average of subscribers has been 5,500.

Annual Meeting of the Erie Telephone Company.

At the annual meeting of the stockholders of the Erie Telegraph and Telephone Company, held in New York, June 9, the following directors were elected: Abner S. Adams, Charles E. Adams, Charles J. Glidden, Francis Jewett, James W. C. Pickering, A. C. Russell and Levi Sprague, of Lowell, Mass.; Wesley A. Gore, of East Boston; James A. Weston, of Manchester, N. H.; Harvey A. Whiting, of Wilton, N. H.; Arthur L. Andrews and George W. Steadman, of Albany; Thomas W. Bartlett, Henry D. W. Burt, Edward W. Carritt, Henry C. Dodge, William Q. Riddle, Henry P. Sewall, Horace H. Smalley, William G. Smythe and H. Frederick Stevens, of New York. The directors organized by electing Levi Sprague as president, Charles J. Glidden secretary and treasurer, and James P. McKinstry general manager. The stockholders of the Southwestern Telegraph and Telephone Company also met and elected the following directors: Charles E. Adams, Charles J. Glidden and Levi Sprague, of Lowell, Mass.; Thomas Sherwin, of Boston; Arthur L. Andrews, of Albany; David B. Parker, Henry P. Sewall, Horace H. Smalley and H. F. Stevens, of this city. The directors elected Mr. Sprague president and Mr. Glidden secretary and treasurer.

The building of a central electric light station, according to the plans of Mr. Kund Bryn, to cost 500,000 kronen, has been sanctioned by the municipality of Christiania, Norway.

The Cincinnati Telephone Case.

This case, which has been in the courts for some time past, was the subject of a decision rendered by the Ohio Supreme Court, June 2. The decision is as follows:

The Cincinnati Inclined Plane Railway Company *vs.* The City and Suburban Telegraph Association. Error to the Superior Court of Cincinnati.

1. The dominant purpose for which streets in a municipality are dedicated and opened, is to facilitate public travel and transportation, and in that view, new and improved modes of conveyance by street railways are by law authorized to be constructed, and a franchise granted to a telephone company for constructing and operating its lines along and upon such streets, is subordinate to the rights of the public in the streets for the purpose of travel and transportation.

2. The fact that a telephone company acquired and entered upon the exercise of a franchise to erect and maintain its telephone poles and wires upon the streets of a city, prior to the operation of an electric railway thereon, will not give the telephone company, in the use of the streets, a right paramount to the easement of the public to adopt and use the best and most approved mode of travel thereon; and if the operation of the street railway by electricity as the motive power tends to disturb the working of the telephone system, the remedy of the telephone company will be to readjust its methods to meet the condition created by the introduction of electromotive power upon the street railway.

3. Where a telephone company, under authority derived from the statute, places its poles and wires in the streets of a municipality, and in order to make a complete electric circuit for the transmission of telephonic messages, uses the earth, or what is known as the "ground circuit," for a return current of electricity; and where an electric street railway afterwards constructed upon the same streets, is operated with the "single trolley overhead system"—so called—of which, the ground circuit is a constituent part, if the use of the ground circuit in the operation of the street railway interferes with telephonic communication, the telephone company, as against the street railway, will not have a vested interest and exclusive right in and to the use of the ground circuit as a part of the telephone system.

Judgment of the Superior Court at General and Special Terms reversed, and petition dismissed.

Our Millionaires.

Lucre has smiled on the explorers in the field of electrical science. No scientific body in the country has so many millionaires as the American Institute of Electrical Engineers. At the top of the list is Alexander Graham Bell, whose profits on the telephone are represented by eight figures. Next comes Edison with a seven figure fortune. Brush, of electric light fame, and Elihu Thomson, whose financial future is perhaps brighter than any of the others just now, are more than millionaires. Frank J. Sprague was a junior officer in the United States Navy six years ago. He is now living in the mansion which was built for the Grants. His company sold out to the Edison Company for $1,000,000, and half of it went to the inventor. Franklin L. Pope, of New York, and a score of others have independent fortunes. Most of these men were telegraph operators, and most of them began their experimenting and study without a dollar.—*St. Louis Globe Democrat.*

The Electrical Production of Ozone.

SIEMENS AND HALSKE'S NOVEL SYSTEM OF VENTILATION.

That peculiarly pungent, exhilarating and refreshing odor which prevails after a severe thunderstorm has been noticed and enjoyed by everyone. This odor slightly resembles chlorine, and is known as ozone, a subtle chemical substance which is the vital principle of the air we breathe, and is known to chemists as O_3. The proportion of ozone in the air stands in a direct relation to the amount of atmospheric electricity present. Electricity is the chief source of the generation of ozone.

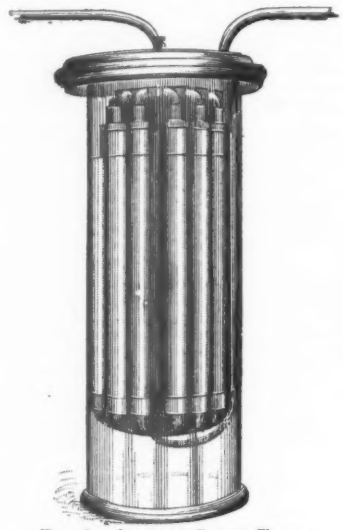


FIG. 2.—SIEMENS OZONE TUBE.

Schönbein, the famous professor of chemistry, was the first to work with ozone. On two occasions, in 1811 and in 1839, he observed the peculiar odor following a lightning discharge. This he supposed to be the same substance which was freed by electrolysis of water and by slow combustion of phosphorous in a moist atmosphere, and proposed to call it ozone, from the Greek verb, meaning "to smell." Since then many investigators have advanced various conflicting theories on the subject.

The great trouble has always been to produce an appreciable quantity of the gas.

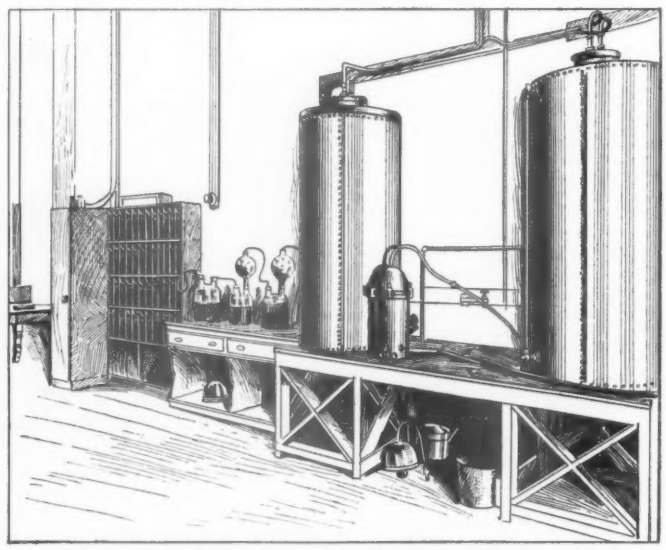


FIG. 1.—OXYGEN GENERATORS AND ELECTRICAL CONNECTIONS.

This was first successfully accomplished by Werner von Siemens, in 1854. He discovered the fact that the silent electric discharge was more productive of ozone than an intermittent electric discharge, and with this as a basic theory he constructed his ozone tubes. These were subsequently improved by Herr von Babo. The matter, however, was still in an experimental stage when Siemens and Halske, of Berlin, completed the task by devising an apparatus for providing an unlimited supply of ozone for the various medical and technical purposes for which it is adapted.

Omitting the many and valuable properties of ozone in connection with the practice of medicine, one of its most valuable technical uses is the purification of air in confined spaces. The apparatus which is about to be described is designed especially for this purpose, and is constructed and exploited in this country, under the authority of Siemens and Halske, by the Ozone Manufacturing Company, 86 Walker street, New York.

In its simplest form, the Siemens ozone tube consists of two very thin glass cylinders, one slightly smaller than the other and closed at one end. These are fitted into one another in such a way that the annular space between the two cylinders is perfectly uniform. The open ends of the two cylinders are then fused together, and the exterior cylinder provided with an adjacent tube, which leads to a circular space. The other end of the exterior cylinder is drawn out to a capillary tube. The interior side of the interior cylinder, and the exterior side of the exterior cylinder, are covered with tin-foil. These tin-foil coverings are connected with the poles of a powerful Rhumkorff coil, producing a continuous discharge of a secondary current at about 14,000 volts pressure over the entire surface of the contiguous sides of the two cylinders; thus a current of air or oxygen passing through the annular space is strongly ozonized. The ozonizing process is accompanied by a beautiful blue fluorescence due to the electrical discharge. This, in brief, is the principle of the apparatus which we illustrate herewith.

In Fig. 1 are shown two oxygen generators with their electrical connections. Fig. 2 illustrates a collection of ozone tubes. The ozone receivers are shown in Fig. 3, while in Fig. 4 is presented a view of the Siemens dynamo and its driving engine.

Pure oxygen is used for the manufacture of ozone for medical purposes. For ventilating service atmospheric air is used. The oxygen is contained under pressure in large iron cylinders (Fig. 1) and is passed through ozone tubes (Fig. 2) after having been thoroughly washed and dried. Here it is ozonized to an extent of about 15 per cent. This ozonized oxygen is carried by means of tin pipes into the receivers (Fig. 3). These receivers are earthenware cylinders, six feet high and three feet in diameter, each holding 26 terra-cotta sieves, which are perforated with a large number of very small holes. Tin is used for the conducting pipes, because it withstands the action of ozone better than any other metal. The cylinder is filled with distilled and sterilized water, holding in solution from .4 to .5 per cent. of certain phosphate salts. The gas, under a pressure of five atmospheres, is introduced into the cylinder at the bottom and caused to pass through the sieves. It is thus brought into contact with a large body of water. The ozone is absorbed by the water and made stable by a patented process. The cylinders are surrounded by a wooden casing, the space between them being filled with ice, which keeps the contents at a constant temperature of about 10 degrees C. The Siemens dynamo is provided with a special set of commutators, shown in the foreground of Fig. 4.

The oxygen is ozonized in the following way: The electric spark divides the molecule of oxygen, whose chemical symbol is O_2, into O+O. In any certain quantity of oxygen only a small portion is dissociated, and the greater number of oxygen molecules remains unchanged. To these unchanged molecules the atoms of active oxygen, O_1, attach themselves, forming ozone, O_3. This, it will be seen, is an electro-chemical reaction. During the process there is also a change of bulk, three volumes of oxygen forming two volumes of ozone. When subjected to a moderately high temperature, ozone is decomposed and oxygen is formed.

This reaction has been the subject of acrid discussion, as it is here that the various theories regarding the formation of ozone have conflicted.

The apparatus illustrated and described herewith is that used by the Ozone Manufacturing Company in producing ozone on

a large scale. For ventilating purposes, the same apparatus is used in miniature. The ventilating appliances consist of an electric motor provided with an especially constructed Siemens commutator, and having a ventilating fan at one end of the armature shaft. This motor is placed in the lower part of a case about two feet square and three feet high, the blower being situated so that a constant suction of air is maintained. This air is led through a drying tube filled with sulphuric acid; from here the cleansed air is fed into the ozone tubes, from which it passes out and is carried by tin pipes along the upper part of the space to be ventilated. This is done because the ozone is heavier than air. Current for the operation of the motor and the electro-chemical action of the ozone tubes, is obtained from any convenient source of supply.

These ozone generators are either sold outright or furnished upon rental. Their operation in America has met with great success, a recent test of the apparatus having been made at the New York Post Office. Postmaster Van Cott is heartily in favor of the scheme and hopes it may be installed in his building. A recent installation is that in the chapel at Wellesley College, Wellesley, Mass. Prof. E. N. Hosford writes that the performance of the apparatus there has more than met with expectations of the college authorities.

FOREIGN ELECTRICAL NEWS.

A mining engineer, Herr Poetsch, has brought forward a project for an underground railway in Berlin. The method of constructing the tunnel will be to excavate 60 entrance shafts by the application of a freezing process invented by Herr Poetsch.

In the vicinity of Geneva the water power of the Rhone is being largely employed for industrial purposes. A report as to the state of the work has recently been made by Colonel Turettini. The canal on the left bank is provided with 20 turbines, with a maximum capacity of 4,400 horse-power. During the past year 216 motors, aggregating 1,565 horse-power, have been driven from the central station. The smallest of these motors have been used to run sewing machines, while one of 625 horse-power has been used to drive the electric light plant for the town of Geneva.

It is announced that a cable will probably be laid, during the present year, between Halifax, N. S., the West Indies and British Guiana. English capital is supposed to be backing the scheme.

A curious use of the electric light is reported from England. At the funeral of a prominent person the family vault was illuminated by incandescent lights, for which a special circuit was carried from the adjacent church.

The collection of electrical apparatus on exhibition at Frankfort-on-the-Main has been insured against fire and damages by explosion to the extent of 3,500,000 marks. The risk has been undertaken by 23 of the principal German insurance offices. Messrs. Siemens & Halske have independently insured their exhibits for 761,000 marks. The value of the exhibition as a whole is estimated at 7,000,000 marks.

At a recent meeting of the British Institute of Electrical Engineers an interesting contribution to the electrical museum was received from Mr. Frank A. Bailey, inspector of telegraphs at Perth, Western Australia. The contribution consisted of two spear heads made by the natives of the Kimberley district, through which one of Mr. Bailey's telegraph lines runs, and were fashioned from Cordeaux's porcelain insulators. Mr. Bailey wrote that one of the spear heads had been attached to a spear nine feet long. President Crookes, in commenting on the gift, said that this was a very remarkable incidence of the ingenuity of the aborigines in making spear heads out of so hard and brittle a substance as porcelain.

Rules for World's Fair Privileges.

At the Centennial Exhibition at Philadelphia in 1874, almost half a million dollars was paid to the management for concessions and in royalties. The amount thus derived at the Paris Exposition was enormous, but the exact figures are not at hand. The Directory of the World's Columbian Exposition believes that a million dollars is a conservative estimate of the probable receipts from this source in 1893. Many applications for privileges and concessions, and inquiries concerning the procuring of them, have already been received, and it is certain that when the time comes for granting them competition in securing them will be very sharp.

The directory committee on ways and means has just adopted rules and regulations governing such concessions, and it is the determination that the visitors to the Exposition shall not be imposed upon in any way or manner whatever by misrepresentation of goods or any sort of sharp practice. A distinction is made by the committee between privileges and concessions. The former refers to the sale of such goods as are manufactured in order to illustrate a machine or process exhibited, while the term concessions applies to the sale of all goods and the operation of attractions from which the securing of revenue is the sole object of the lessees. All applicants for concessions must state the space they require, and whether or not a special building will be required This class includes the restaurants and dispensers of soda water, cigars, tobacco, photographs, guide books, rolling chairs, cut flowers, confectionery, bakery supplies, lemonade, messenger service, telegraph service and perfumery.

RULES GOVERNING PRIVILEGES.

The rules which have been adopted are the following:

1. Lessees and such employés or assistants as may be necessary for the proper conduct of the business will have full access to the Exposition grounds, but they will be subject at all times to the general rules and regulations of the Exposition, and shall enter such gates and at such hours as may be designated by the Exposition management.

2. No business under any of the concessions shall be conducted in other than a first-class, orderly manner. No gambling or games of chance will be allowed anywhere within the Exposition grounds.

3. All buildings, stands or booths leased or erected for concessions shall be open at all reasonable hours to the inspection of the director general, and such agents as may be designated by the Exposition management.

4. No transferring or subletting of any interest in the concessions granted will be allowed without the written consent of the Exposition management.

5. No employé or assistant of lessees of concessions shall enter upon his duties until his name and address have been registered in the office of the committee on ways and means, who will designate an official number which shall attach to said employé or assistant, and such number must be worn conspicuously by said employé or assistant when on duty, and used as the rules may designate.

6. All goods sold must be what they are represented, and no deception will be allowed.

7. Wagon gates will be open at 5 A.M. and closed at 8:30 A.M. for the purpose of admitting supplies to all those having concessions; all supplies must be brought in between those hours. Only such articles as are covered by the concession will be admitted without a special permit.

8. All stands, counters and fittings, together with all decorations, to be erected at the expense of the lessee; plans of the above to be subject to the approval of the director-general.

9. Solicitations for the sale of goods will not be allowed.

10. Concessions will be limited to a given number of the same in each class or branch concerning which concessions are granted.

11. Lessees will be required to keep their premises clean and in complete order at all times, and shall not permit any violence, coarse or insolent language or unnecessary noise about their premises. Any employés or assistants wearing the number assigned by the Exposition management, appearing upon the grounds at any time intoxicated, making unnecessary noise or using coarse or insolent language, will be deprived of their number and be immediately and permanently expelled from the grounds.

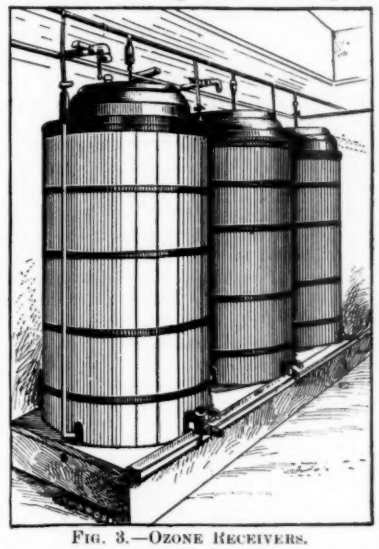


FIG. 3.—OZONE RECEIVERS.

12. Persons procuring concessions to sell foreign goods will be subject to the above rules in addition to the regulations issued by the Secretary of the Treasury of the United States for the protection and collection of the revenue.

13. Any person who attempts to sell or expose for sale on the Exposition grounds, or in any of the buildings erected thereon, any article whatever, without having first obtained a concession for such purpose, will be forthwith ejected from the Exposition grounds and prosecuted to the full extent of the law.

14. Any violation on the part of lessees of any of the rules governing the Exposition or concessions will make void their contract at the option of the Exposition managers.

15. All lessees, assistants and their employés must leave the grounds within two hours after the close of the Exposition.

16. The Exposition management reserves the right to amend or add to these rules whenever it may be deemed necessary for the interests of the Exposition and the public good.

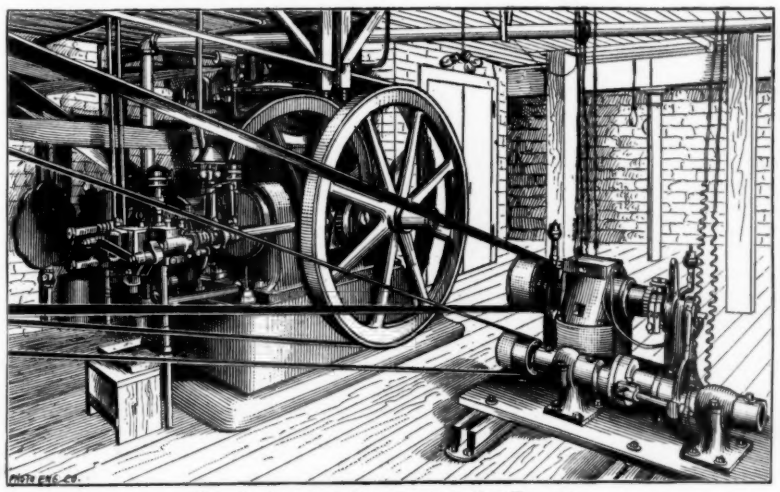


FIG. 4.—SIEMENS DYNAMO AND GAS ENGINE.

One of our English contemporaries voices the demand for a small, cheap and durable battery for laboratory work. The desire is especially expressed for a set of 100 small cells in a portable case, which would be most valuable for insulation testing and similar work.

TELEGRAPHIC

.... The Western Union Telegraph Company is putting up a new line between Akron and Cleveland, Ohio.

.... The Western Union Telegraph Company has completed the line from Tacoma to Montesano, opening offices at Elma, Harlow Junction, Oakville and Grand Mounde, Wash. The line will probably be extended to Aberdeen, Wash., within a few weeks.

.... The Commercial Cable Company has raised objections to the introduction of electric street cars into Rockport, Mass., on the ground that the presence of so strong a current of electricity in the vicinity of the cable would seriously interfere with the workings of the delicate instruments in use.

.... The directors of the Central and South American Telegraph Company, at a meeting held in New York city, June 10, elected these officers: James A. Scrymser, president; Edward D. Adams, vice-president; Sebastian Camacho, resident vice-president, city of Mexico; Samuel B. Blackwell, treasurer and auditor; James R. Beard, secretary.

.... The little Alpena *Echo* cuts off its daily telegraph service because it could not tell why the great head in the telegraph company caused it to be sent a full account of a flood in Shanghai, a massacre in Calcutta, a monkey dance in Singapore, a sailor fight in Bombay, hard frosts in Siberia, a missionary banquet in Madagascar, the price of kangaroo leather in Borneo, and a lot of nice cheerful news from the Archipelagoes, and not a line about the Muskegon fire.—*Detroit News.*

About Clams.

The following from the Chicago *Tribune* is published for the benefit of Mr. Eugene F. Phillips and his happy fraternity of clam eaters, all of whom appreciate a good story, to say nothing of the application of this one to the man from New Jersey, who couldn't see the point:

Ex-Governor Hoard is one of the best story tellers in the country. On the recent trip to Galena, when the Grant monument was unveiled, his fund of stories seemed inexhaustible. One of them was this:

"I was down at a little clambake in New Jersey last summer, and after dinner was called on to make a speech. I started off by saying that I had eaten so many of their low-neck clams that I wasn't in the best sort of condition to make a speech. When I used the expression 'low-neck' clams, an old chap sitting directly across the table from me, whose face was long enough to enable him to eat oats out of a churn, scowled at me, and then said, in a stage whisper: 'Little Neck clams, little necks—not low necks.' I paid no attention to the interruption, and finished my speech. When dinner was over he trailed me out into the hall, and said: 'You are from Wisconsin, ain't you?'

"'Yes,' I replied.

"'You don't have many clams up there, I reckon?'

"'Well,' I said, 'we have some, but it's a good ways to water, and in driving them across the country their feet get sore and they don't thrive very well.'

"He gave me a look that was worth a dollar and a half, and in a tone of the utmost disgust said, 'Lord! clams ain't got no feet.'

"He turned away, and, approaching one of my friends, inquired: 'Is that fellow Governor of Wisconsin?'

"'Yes,' said my friend.

"'W-a-l-l,' drawled the old man, with a good deal of feeling, 'he may be a —— smart man in Wisconsin, but he is a —— —— fool on the seashore.'"

At the last meeting of the British Institute of Electrical Engineers, Sir William Thomson surprised many of his hearers by avowing a decided preference for the low tension direct current system of supply, because, to his mind, it possessed greater simplicity than the alternate current systems.

* * The Cicero and Proviso Electric Railroad will be extended to Dunning and Jefferson, Ill.

* * Port Townsend, Wash., is to have an electric line five miles in length, to be completed by August 1.

* * The Shaw Electric Crane Company will add $40,000 worth of machinery to its Muskegon, Mich., plant.

* * The Hempstead, L. I., town board refused to grant a franchise for an electric road beetween Rockaway and Far Rockaway.

* * An electric railroad, 40 miles long, will probably be constructed between Asheville and Rutherford, N. C. The generators will be run by water-power.

* * The electric street cars have now run over 5,000 miles, and not a single mishap has happened to prevent them from running on regulár time.—*Milford, Mass., News.*

* * The Denver, Lakewood and Golden Electric Railway Company have placed their bonds on the Eastern market, and will have the road in operation in less than 60 days.

* * The Boston *News Bureau* hears on best authority that the operating expense of the West End railway system at the present time, covering both horse and electric power, is 63 per cent.; that of the electric department, 53 per cent.

* * Marseilles, France, has decided to adopt the overhead electric system for street car propulsion, and a new street car line, for which a franchise was recently obtained, will be built in accordance with it. The plant will be the first high tension electric installation of its kind in a large city in France.

* * Orlando W. Norcross, of Worcester, proprietor of the Franklin Electric Motor Company, with others, has purchased a controlling interest in the Essex, Mass., Electric Street Railway Company. At a meeting of the directors, held last week, Mr. Norcross was elected president and Frank E. Farnham treasurer.

* * Large ventilating exhaust fans with "C. & C." motors connected directly to fan shafts have been running for several months past in the Pennsylvania State Capitol Building, at Harrisburg, one in the Assembly and the other in the Senate Chamber. The members have been most enthusiastic over the success of these machines and have passed resolutions testifying to the great improvement the outfits have effected in the atmosphere of the rooms.

The Brush Storage Battery Suit.

Judge Coxe, of New York, last week took up the case of the Brush Electric Company and the Electrical Accumulator Company. Decision was reserved. Litigation has been in progress for some time, and the final decision in the case involves the sole right to manufacture or sell storage batteries in this country for the next 12 years.

The suit was instituted four years ago by the Brush Electric Company for infringements by the defendants of the storage battery patents of Charles F. Brush. The patents have already been before the same court in the case of the Brush Company against the Julien Electric Company. The defendants claim they will make a stronger fight than the Julien Company put up in the other case.

Some time ago the patents were licensed exclusively to the Consolidated Electric Storage Company, the successor of the Julien Company, and it is this former company which will be benefitted if the Brush Electric Company wins the suit. It is expected that a great deal of high class expert testimony will be taken, among the witnesses called being Professors Cross, Brackett, Morton, Chandler and Mr. Edward Weston.

New Factory and Offices of the Crocker-Wheeler Electric Motor Company.

The establishment of the Crocker-Wheeler Electric Motor Company, West Fourteenth street, New York city, has been enlarged, and the alterations, which have been going on for some time in the old portion of the plant, are completed. Access to the company's quarters is now furnished by a new entrance on West Fourteenth street. The staircase lands one in the exhibition room, which is well lighted and neatly finished in hard wood. A number of motors, $\frac{1}{12}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{1}{3}$, 1, 3 and 5 horse-power, are exhibited in connection with electric disk ventilating fans, electric pumps, etc.

Other applications noticed are a $\frac{1}{2}$ horse-power motor driving a 2x1$\frac{3}{4}$ inch triplex pump, and a $\frac{1}{2}$ horse-power motor driving a 1$\frac{1}{4}$x2 inch triplex pump (Goulds Manufacturing Company pattern). These pumps work very smoothly.

In the exhibition room, on a long table, is also shown the Crocker-Wheeler motor dismembered, so that the various parts and stages of its construction can be readily understood and appreciated. The high character of the materials employed and the unusual perfection and finish of every part is clearly seen. The company exhibit with pride all these parts, considering that it is the most convincing way of showing the merit of their motor. Here, also, is found a great deal of information in the way of pamphlets, and other printed matter, regarding the well-known specialty of the Crocker-Wheeler people.

To the right of the exhibition room comes, first, the office of Messrs. F. B. Crocker and S. S. Wheeler, a pleasant, well lighted and cozy room, nicely furnished with polished oak desks, chairs and other necessary office fixtures. It will also be used for board meetings. Next are the quarters of the able secretary and general sales-agent of the company, Mr. Geo. W. LaRue, from which communication is had with the general business office and drawing room, presided over by Mr. W. H. Geers, the assistant secretary. The shops and testing room are located to the left of the exhibition room, and run the entire length of the block between West Fourteenth and West Thirteenth streets, and are fitted throughout with the finest machinery obtainable, necessary for the company's manufacture. The Crocker-Wheeler Electric Motor Company employ about 150 hands, and hope before long to keep abreast of their orders. They find the new quarters a great convenience and improvement over the old establishment. Messrs. Crocker and Wheeler give the closest attention to the details of the manufacturing work, to maintain perfection of every part, which is the great feature of their motors, and for which the machines justly enjoy a wide reputation.

On Signaling Across Rivers in India with Cardew's Vibrating Sounders.

READ BEFORE THE BRITISH INSTITUTE OF ELECTRICAL ENGINEERS, BY W. F. MELHUISH, MEMBER.

Adverting to my paper on "Signaling Across Rivers in India," which was read at the Institution of Electrical Engineers on April 10, 1890, the following will show how the researches subsequently became of practical value:

2. Of the several telegraphic circuits which are led out of Calcutta to various parts of India, there are five which branch off almost due east. Three of these circuits convey traffic for Upper and Lower Burma, and the remaining two are utilized for the Dacca, Chittagong and neighboring traffic. The country through which the lines above referred to pass is intersected by rivers, most of which, owing to their great breadth, are cabled.

3. The first river out of Calcutta, called the Pudda is seven miles wide, and is cabled at two separate points about 12 miles apart. On the morning of September 8, 1890, two out of the five cables which cross this river in the circuits above alluded to, became interrupted. The tests gave evidence of rupture of conductor with partial earth.

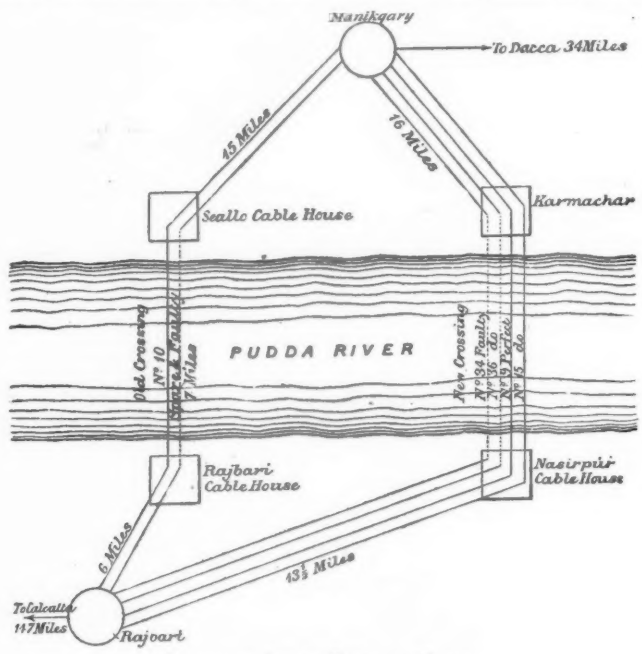
4. The river being in full flood at the time, it was out of the question to attempt to repair the cables; and, moreover, a boat service to convey messages from bank to bank, though practicable, would have been slow and costly. It was resolved, therefore, to endeavor to utilize the Cardew vibrating sounders.

5. The accompanying sketch shows the length and position of the cables and land lines utilized during the experiments. The dotted line represents a spare cable which has been interrupted for some time owing to an insulated break in the conductor.

6. The following were the experiments tried:

Experiment I.—To work through the guards of the cables at the old, and the guards of the cables at the new crossing, using the former as line and the latter as earth. While this experiment was being carried out the land lines between Seallo and Manickgunge got into contact, putting a stop to the experiment. A few signals had, however, been passed through this complete metallic loop, and from the strength of these signals it is thought the experiment would have been entirely, instead of but partially, successful, had the experiment not been interrupted.

Experiment II.—To work through the guards of the cables at the east crossing, using any of them as line, with the land line on either side earthed at Dacca and Rajbari. The vibrators were somewhat in the middle of the circuit, *i. e.*, at the two cable houses.



Signaling Across Rivers in India.

7. To enable Experiment II to be made, the Rajbari and Dacca offices were directed to "earth" the connecting land lines, and the vibrators were inserted at the cable-houses at Nasirpur and Kurmachar, the guards of one of the cables being used as line, and the land lines on either side being used as earths. Although this arrangement does not provide a complete metallic circuit for the current, the experiment was, nevertheless, *quite successful*, the signals being very clear, and readable at a distance of about four inches from the ear. The success met with in this experiment is an important and valuable advance on all previous attempts to signal across Indian rivers.

8. In addition to the experiments named, the vibrators were joined up through the severed conductor of the spare cable at the western crossing, and the signals passed through this were also loud and distinct.

9. It will be seen from the foregoing facts that the vibrating sounders have been of practical use in establishing telegraphic communication across one of the widest rivers in India, at a time when no other yet known means might have been possible. The success of Experiment II greatly made up for the sudden failure in the conductors of two cables, and enabled the Indian Telegraph Department to dispose of a certain amount of local traffic, thereby keeping free the Burma lines for their legitimate work, preventing their congestion, and obviating delays to messages which might otherwise have ensued.

The Ball & Wood Company's Plant.

The new plant of The Ball & Wood Company, at Elizabethport, N. J., promises to be a model in equipment and convenience for building the improved Ball automatic cut-off engines. With a stretch of 900 feet between the main tracks of the Central Railroad of New Jersey, and Trumbull street, with the Singer Park at one end and the railroad station at the other, it is an ideal manufacturing site. Two railroad sidings will serve, one the main machine shop into which it passes, and the other the foundry, which at present is in contemplation.

From the New York City Hall to the factory station is exactly 10 miles, and a long distance telephone will connect these points, placing purchasers of engines in instant communication with the source of supply. In the main machine shop, even a wide-awake engineer will be impressed with the mechanical progress made in the last decade. A glance will embrace an enormous room, light and airy, 70 feet high to the roof, and flanked with wide and substantial galleries sustained by iron columns. Overhead a Shaw electric crane will noiselessly raise a completed compound engine of 20 tons from the testing block, carry it the length of the shop and place it on a car in readiness for shipment. On either hand are new and massive tools, the latest product of shops both East and West, and throughout the entire establishment an air and order of system prevails which in itself will guarantee substantial and excellent work.

It is the intention of the company to increase its plant by adding in length when it becomes necessary, and this can be done without interrupting the work in progress. A number of orders for the improved Ball engines are already entered, and in another month the factory will be a busy scene, well worth the inspection of engineers as well as purchasers of this well known engine.

A Proposed Government Telegraph Line.

It is the intention of the Bureau of Ordinance, Navy Department, to erect a telegraph line from the Navy Yard, Washington, to the Naval Proving Grounds, at Indian Head, about 30 miles down the Potomac. Proposals for furnishing the material and building the line are invited by the Bureau. About 700 twenty-four foot poles and cross-arms, 1,400 brackets and insulators, and 60 miles of No. 8 galvanized wire, will be required in the construction of the line.

Professor Jacques and the Mob.

DETAILS OF AN AMERICAN ELECTRICIAN'S UNPLEASANT EXPERIENCE IN FLORENCE, ITALY.

We chronicled, recently, brief news of the attack upon Prof. W. W. Jacques, electrician of the American Bell Telephone Company, by a mob at Florence, Italy. The matter proves to have been of a more serious nature than was at first reported. Professor Jacques has written an account of his experience to the Boston *Globe*. We print below a part of his letter:

"While driving along the Vialle Principe Amedo, one of the most respectable residence streets of Florence, a mob of several hundred men suddenly rushed out of a side street in front of our carriage. I told the coachman to turn and drive back, when we were surprised to see a similar mob pouring out of a side street behind us. We were instantly surrounded by the mob, every individual of which seemed to have his hands full of the large and rough stones used here for repairing the streets. Somebody in the crowd cried: 'Americans! Let us lynch them.' (This I am told by my driver.) 'Death to the rich,' etc. The mob then began pelting our carriage with stones. Fortunately, we had a good, strong sun umbrella spread over our heads. I made my little girl get down under my arm and sheltered our heads with the umbrella as best I could. I was struck on the shoulder, the side, the leg, and on the head (a good American derby saved that). Then the umbrella was demolished and a stone struck my little girl two inches below the right temple. The wound was deep and the blood soon saturated her clothing and my own, and, curiously, ran into my basket and stained my passport, signed by James G. Blaine, requesting foreigners to allow me and my family to pass safely, etc.

"Meanwhile, our coachman had forced his way through the crowd. He wheeled into a side street and drove rapidly to our hotel, followed for some distance by the mob. On arrival at our hotel my little girl was carried to her room, and an English physician staying in the house took immediate charge of her. He said it was an exceedingly narrow escape from death. Now, one month later, that the wound has nearly healed, we can see that it will leave a scar that will disfigure her face for life.

"In the afternoon I drove to the American Consulate and reported the matter substantially as above, and was assured that every action would be taken by the Italian authorities to arrest and punish the offenders. I have since learned that many arrests were made, and as there were many witnesses, no doubt conviction and punishment will follow. Several prominent Italian residents of Florence also called on me and expressed regrets and assured me that the mob was largely made up of ruffians from other cities who had come there to promote the Socialist demonstrations of May 1.

"As several other carriages, occupied by Italians, were assaulted that day, I was at first of the opinion that our nationality had nothing to do with the matter, but the statements of my coachman seem to leave no doubt that the cries of the leaders of the mob, which cries were the immediate cause of the result, were, 'Americans! Let us lynch them.'

"Whether the Italian government punishes these offenders remains to be seen. They made every effort to hush up the matter, even going so far as to open and read my telegrams, in which I attempted to communicate with my friends in America, and later the telegrams from my friends to me. This seems to me a striking disregard of the requests of our government contained in my passport."

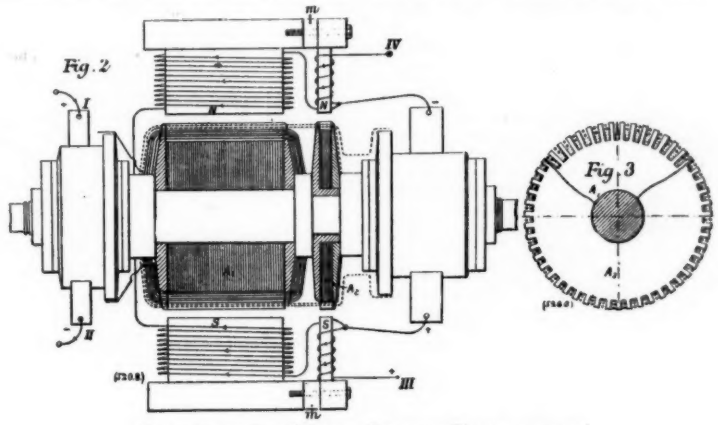
Mr. Edison Sued for $250,000.

E. B. Welsh, of Boston, has brought suit against Thomas A. Edison to recover $250,000 damages for an alleged half interest which he claims to have in all the inventions and improvements made by Edison in transmission of messages by telegraphy. This suit was brought in 1884 in the United States Circuit Court, and the plaintiff claims that Edison made a compact in April, 1869, by which he agreed in consideration of various sums of which Welsh had loaned him to experiment on the invention which he was at work upon for use in telegraphic transmission. At Boston, June 13, in the Circuit Court, before Judge Nelson, a motion was made by the defendant to have an auditor appointed, that the plaintiff be ordered to produce certain documents which defendant thinks are in his possession, and that the court order the plaintiff to answer certain interrogatories.

The plaintiff makes objection to answering these interrogatories, and also objects to the other motions of the defendant. The defendant's answer in the case says that the plaintiff has no rights against him at law, and that the alleged agreement was of a limited time, and has been satisfied and terminated.

A German Current Transformer.

To convert high tension continuous current into low tension, one method is to drive by means of a high tension motor a low tension compound dynamo. Such combinations are built by Deprez, Schuckert and others, and are termed by them motor dynamos. A simple method for transforming currents consists in having only one armature, wound, however, both for the high tension supply and the low tension resultant current. This form of current transformer with but one magnet field is a construction of high practical value; the cost is smaller, the efficiency higher, and the result in regards to sparking more satisfactory than in the motor dynamo. Its only drawback is that it has not perfect regulation, or that amount of compounding which, given a constant primary electromotive force, supplies a secondary electromotive force, irrespective of the load. The primary and secondary windings of the magnet require to be arranged to give opposite polarities, the transformer cannot, therefore, be regulated by simply altering the magnetism.



FIGS. 2 AND 3.—GERMAN CURRENT TRANSFORMER.

Referring to the illustrations on this page, Fig. 1 shows the external appearance of the Lahmeyer current transformer, while Figs. 2 and 3 show the details of construction. This apparatus is now being exhibited at Frankfort. From the branches I II the high tension current flows to the armature A and its magnet frame. For tensions up to 600 volts and small sizes, Mr. Lahmeyer constructs his transformer with drum armatures, placing, as shown in Fig. 3, the two armature coils, with an insulated division, above one another. In the case of larger patterns, Mr. Lahmeyer uses the Gramme ring form for both armatures; the coils are in this case side by side, each bobbin in a separate groove. The grooves are covered with a thick layer of fibre insulation, and each bobbin is singly accessible and exchangeable.

If it be remembered that in motor dynamos, with two armatures on the same shaft, the insulation of the two coils from each other is only formed by the covering around the armature cores, since it is not mechanically convenient to introduce a non-metallic part, it will be admitted that even in respect of accessibility and mechanical security nothing has been sacrificed.

Compared to the motor dynamos a transformer of this construction has the advantage of reduced size and cost. According to Mr. Lahmeyer's statements, the efficiency of these transformers is the same as that of dynamos of the same size, and with equal excitation the transformer works with a higher degree of magnetic saturation, because the reactions of the armature coils balance each other; it is, moreover, well known that this latter condition obviates sparking. The efficiency of large transformers may, therefore, be taken as 92 per cent., a saving of 8 per cent. over motor dynamos, which is of considerable importance, particularly in long lines. The attendance required is less for the transformer than the motor dynamo, owing to absence of any appreciable influence of heating of the

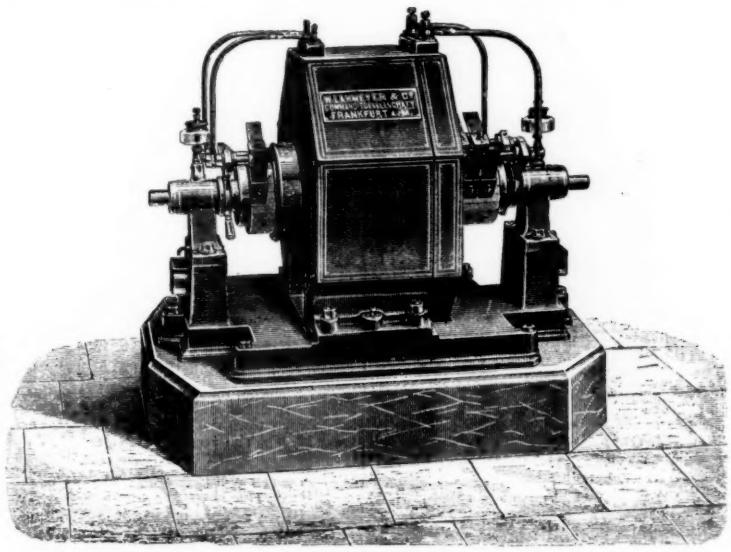


FIG. 1.—GERMAN CURRENT TRANSFORMER.

coil, wound upon the main armature A_1, while the secondary coil, besides surrounding the armature A, also passes round the armature A_2. Acting upon this latter is a field magnet III IV, upon which circulates the secondary main current. The current in this coil is proportionate to the difference of current of the armature A_1; the additional electromotive force of the armature A_2 is also proportional to it. Without adding any special commutator or any parts liable to wear or requiring special attention, the compounding of this transformer is thus accomplished. The compound magnetic field is separated from the main field by an insulation of brass M, N. The armature A_2 and the field magnet belonging to it are thus separated from the main magnet. The dimensions of these latter have to be increased so as to obtain the necessary tension without wires upon the tension of the current. This transformer offers, hence, the simplest means of distributing continuous currents over large districts. Where accumulators are used, Mr. Lahmeyer constructs the regulator frame of the larger dimensions, and provides, besides the direct, an auxiliary terminal winding or coil. When charging the accumulators, both coils are switched in, thus causing additional electromotive force; for working in parallel circuit only the one is used. A charge of polarity in the transformer cannot take place.

This transformer can be directly connected over long distances with a source of high tension, without requiring any other means for regulating the tension, which materially simplifies the arrangement of a large current distribution, thus obtaining all that can be expected for continuous currents.—*London Engineering.*

ELECTRIC LIGHT NEWS

—— A bill giving boroughs the right to establish their own electric lighting plants has passed the Pennsylvania legislature.

—— The Roxbury, Mass., electric light company, which was organized in 1889, has become extinct by a decree of the Supreme Court.

—— The Thomson-Houston Electric Company is constructing six 14-inch projecting search-lights for the United States government, to be used on launches.

—— The stockholders of the Dover, N. H., Gas Light Company have voted to lease its plant to the Consolidated Light and Power Company for a term of 20 years, at a rental of 6 per cent. on its capital stock of $83,000.

—— At the annual meeting of the Thomson European Electric Welding Company, at Portland, Me., June 10, the following directors were chosen: Oliver Ames, Benjamin F. Spinney, George P. Meserve, S. Endicott Peabody, Henry D. Hyde, Prentiss Cummings, Joseph N. Swett, Royal G. Robbins, Francis Peabody, Jr.

—— The Edison General Electric Company has been awarded the contract for fitting the new Manitoba Hotel, at Winnipeg, Man., with combination electric light and gas fixtures. The designs throughout are of a very handsome and ornamental character, and in the great dining hall in particular the illumination will be extremely brilliant and probably superior to anything of the kind in Canada.

—— The Westinghouse reorganization committee offers the stockholders of the New York Consolidated Electric Light Company, subject to the success of the general reorganization plan, opportunity to exchange their stock for 25 per cent. in the Westinghouse seven per cent. preferred stock, and 50 per cent. of the Westinghouse common "assenting" stock, provided for in the plan of reorganization.

—— The Brush Electric Company, of Cleveland, on June 8, quitclaimed its entire plant to the Old Colony Trust Company for the nominal consideration of $1. The transfer was made to secure a series of first mortgage bonds for $500,000, which were issued to indemnify the minority stockholders who were not satisfied by the recent transaction through which the corporation was absorbed by the Thomson-Houston Electric Company.

—— A warrant was issued last week, for the arrest of P. H. Fahr, of Hoboken, N. J., on a charge of malicious mischief. Superintendent Banta of the Hoboken Electric Light Company is the complainant. Mr. Banta observed that Mr. Fahr's residence at No. 415 Washington street, was illuminated by electricity. The superintendent found that Fahr's name was not upon the company's book. He went to Fahr's house and discovered that the wire which supplies the current for the street light on the corner had been tapped and led into Mr. Fahr's house.

Engineering Equipment Co.—Underwood Man'f'g Co.

Mr. F. A. Magee, M. E., will be in charge of the Boston office from June 1, 1891, as the representative of the Engineering Equipment Company, 143 Liberty street, New York, contractors for steam and electric equipment materials, and Eastern selling agents for The Underwood Manufacturing Company. The patent cotton-leather belts, made solely by The Underwood Manufacturing Company, and the Dodge "Independence" wood pulleys, will be found in stock, as heretofore, at the Boston office and sales rooms, 126 Pearl street.

THE POLAR DIAGRAM OF ALTERNATE CURRENTS.

(*Continued from page 224.*)

law of the polygon of sine waves to a resulting wave."

In the same way, if OC_1 and OC_2 represent two E. M. F.'s working in series in the same circuit, they will combine to a resulting E. M. F., OC, which can be considerably smaller than the sum of the component E. M. F.'s.

The resulting wave can even be smaller than either one of the component waves. This becomes possible when the angle of difference of phase between both, $\angle)\ \omega$, is larger than 120°.

From the parallelogram law we derive

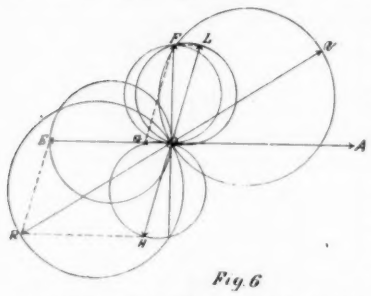


Fig. 6

directly those laws, which in alternate current circuits take the place of Kirchhoff's laws of continuous current distribution:

(1.) *"All the alternate currents flowing to or from one distributing point are in their polar diagram represented in phase and size by lines, which, laid together, give a closed polygon."*

(2.) *"All the alternate E. M. F.'s (including the E. M. F. converted into heat by the electric resistance of the conductor) acting in a closed circuit, combine in their polar diagram to a closed polygon."*

For "*current*," "*E. M. F.*," etc., as here used, either the *maximum value* may be understood, or more conveniently, the "*effective value*" that is, the *square root of the mean square*.

This polar diagram of sine waves we shall apply now in considering the phenomena going on in an *inductive resistance*.

First, it may be supposed that the magnetic field of the inductive resistance contains *no iron* or any other material of variable magnetic conductivity.

Let n=50, the *number of turns* of the coil, which represents the inductive resistance.

Let R=1.2 Ω, the true or ohmic *resistance* thereof.

Let $\sigma = 100$, the *magnetic conductivity* of the magnetic circuit produced by the coil, that is: 1 ampere turn produces 100 lines of magnetic force surrounding all the 50 turns of the coil (or 200 lines surrounding only half the coil, etc.).

Let N=100, the *number of complete periods* of the alternate current per second.

We suppose, first, that there are no eddy currents or secondary induced currents produced by the alternate magnetism of the inductive resistance.

Let the *current* in the coil C=50 amperes maximum value.

Then the *M. M. F. of the inductive resistance*, that is, the number of ampere turns, is given by F=nC=2,500 ampere turns.

Now, in counting the time from that moment where the current c, and therefore the M. M. F., f=0, and representing 1 inch = 2,000 ampere turns, the M. M. F. f is represented in the polar diagram Fig. 3 by the circle with OF=1.25 inch as diameter, which maximum occurs at the angle 90°.

In the same way the *current* c is represented in the polar diagram by a circle with its maximum value as diameter, and the phase 90°.

Representing 1 inch=40 amperes, the current c is represented by the same circle as the M. M. F. f.

This M. M. F. F produces the *magnetism* $M = F\sigma = nC\sigma = 250{,}000$ lines of magnetic force.

The E. M. F., induced in n=50 turns by the magnetism M=250,000, alternating with the frequency N=100, is $E = 2\pi nNM\ 10^{-8} = 2\pi n^2\sigma\ NC\ 10^{-8} = 78.5$ volts maximum value, and is a maximum ¼ of a period, or 90° after the maximum of magnetism M, or of M. M. F. F, that is, at the angle 180°.

Therefore, assuming, 1 inch=50 volts, the induced *E. M. F.* E is represented in the polar diagram by the circle with OC = 1.57 inch as diameter.

The heating E. M. F., that is, the E. M. F. converted into heat by the electric resistance of the conductor, is H = RC = 60 volts maximum, and reaches this maximum at the angle 270°, opposite to the maximum of the current. For the heating E. M. F. is always opposite and proportional to the current which produces it.

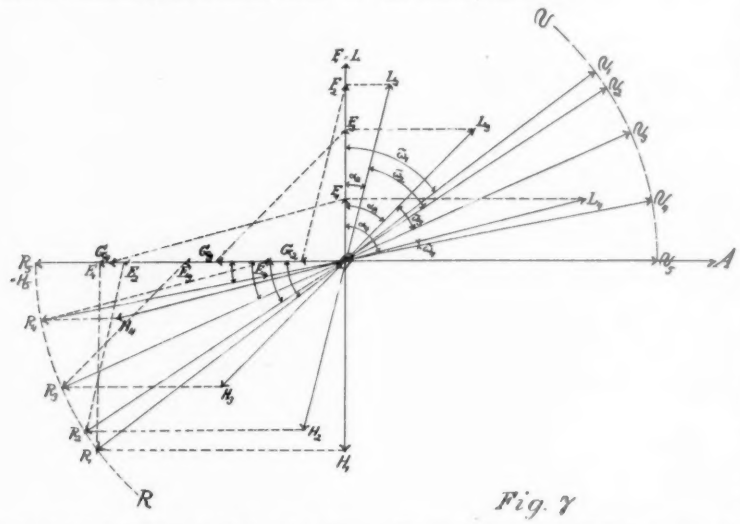


Fig. 7

Hence, this heating E. M. F. is represented by the circle with OH=1.2 inch as diameter.

Now, the *induced E. M. F.* OE=78.5 volts =1.57 inch, and the *heating E. M. F.* OH=60 volts=1.2 inch combine by the parallelogram of sine waves OERH to the *resulting E. M. F.* OR=1.98 inch, that is, R=99 volts.

OR is the E. M. F. consumed by the coil. It must be furnished by the *impressed E. M. F.* V.

Hence, the impressed E. M. F. is V=99 volts, and is represented by the circle over OV=1.98 inch as diameter, exactly opposite and equal to the resulting E. M. F. OR.

Hence, an impressed E. M. F. V=99 volts maximum value, will send a current of 50 amperes maximum value through the inductive resistance, with a *retardation*, or *shifting of phase* between current and impressed E. M. F. $\angle)\ \omega$=VOF=53°.

Now, suppose we connect this coil with the terminals of a 100 volt alternating circuit.

100 volts effective corresponds to $100 \sqrt{2} = 141.4$ volts maximum E. M. F.

Then, to produce the polar diagram for the impressed E. M. F. 141.4 volts, we lengthen OV, in Fig. 4, until it equals 2.83 inch, corresponding to 141.4 volts, and enlarge the whole diagram proportionally.

Then we get: Impressed E. M. F. OV_1=2.83 inch, V_1=141.4 volts; induced E. M. F. OE_1=2.24 inch, E_1=112 volts; heating E. M. F. OH_1=1.71 inch, H_1=85.5 volts; M. M. F. OF_1=1.785 inch, F_1=3,570 ampere turns; current OC_1=OF_1=1.785 inch, C_1=71.4 amperes, the shifting of phase between current and impressed E. M. F. remaining the same, $\angle)\ \omega$=53°.

Now, at any time the instantaneous values

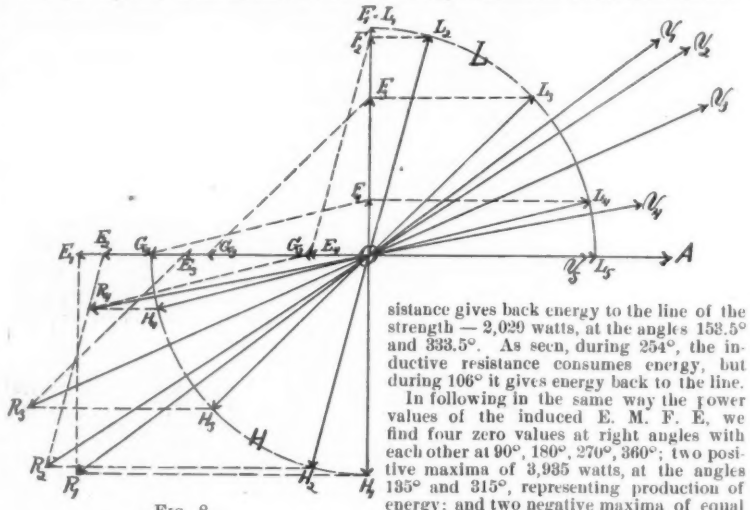


Fig. 8.

of the electric quantities can be read directly from the diagram, by drawing the circles over the maximum values as diameters. In Fig. 4, these circles are left out, as can be done everywhere, where the instantaneous values are not considered, but the maximum values, or the "effective values," which are proportional to the maximum values, with the factor $\frac{\sqrt{2}}{2} = .707$

The instantaneous power, or energy, of the electric quantities, for instance, of the impressed E. M. F. V, is at any moment, for instance, at the time t, represented by the angle AOy, $p_2 = v_2 c_2$, hence, in Fig. 5, it can be represented in a simple way.

Produce v_2, p_2, ⊥ OC.

Then it is $\triangle Ov_2$, $p_2 \sim OC\ c_2$.

Hence, $Ov_2 \times Oc_2 = Op_2 \times OC$.

That is, the electric power of the impressed E. M. F. V at the moment Oy is represented by the projection Op_2 of the instantaneous value of the impressed E. M. F. Ov_2, upon the maximum current OC, multiplied into this current.

Hence it is at the time: $t_1 = .002$ and $t_2 = .003$, represented by the angles $\vartheta_1 = 72°$ and $\vartheta_2 = 108°$, $Op_1 = 2.2$ inch, $Op_2 = .9$ inch, and because OC = 1.785 inch; $Op_1 \times OC = 3.93$ square inch; $Op_2 \times OC = 1.6$ square inch; but 50 volts = 1 inch, and 40 amperes = 1 inch; hence, 2,000 watts = 1 square inch,

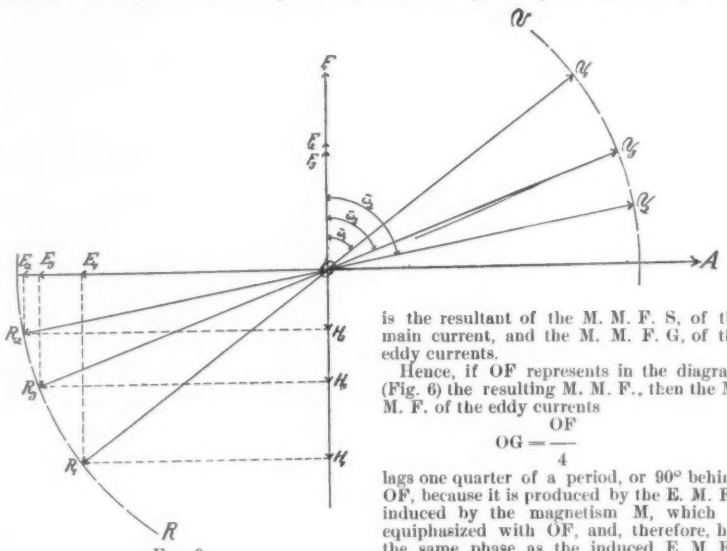


Fig. 9.

and, therefore, p_1 = 7,860 watts, p_2 = 3,200 watts.

In this way we derive the result: *"In the polar diagram of alternate currents, the instantaneous values of the electric energy are given by the projections of the instantaneous values of the E. M. F. upon the maximum current multiplied into this maximum current or by the projections of the instantaneous values of the current upon the maximum E. M. F. multiplied into the maximum E. M. F."*

The one or the other representation may be used, according to convenience.

By following the instantaneous values of the energy of the impressed E. M. F. over the full period of the current we see that the energy of the impressed E. M. F. becomes equal to 0 four times during each period; that is, when the current = 0 and when the impressed E. M. F. = 0 for the angles: ϑ = 127°, 180°, 307°, 360°, and it reaches, as seen from the diagram, four maxima during each period, midway between the zero values, two positive maxima where the inductive resistance consumes energy of the strengh 8,080 watts, at the angles 63.5° and 243.5°, and two negative maxima where the inductive resistance gives back energy to the line of the strength — 2,020 watts, at the angles 153.5° and 333.5°. As seen, during 254°, the inductive resistance consumes energy, but during 106° it gives energy back to the line.

In following in the same way the power values of the induced E. M. F. E, we find four zero values at right angles with each other at 90°, 180°, 270°, 360°; two positive maxima of 3,935 watts, at the angles 135° and 315°, representing production of energy; and two negative maxima of equal size as the positive maxima, — 3,935 watts, at the angles 45° and 225°, representing consumption of energy; and we see that in the whole the induced E. M. F. neither consumes nor produces energy, but only converts electric energy into magnetic energy and backwards. On the other hand, the heating E. M. F. H reaches only two zero values, at 0° and 180°, and two negative maxima at 90° and 270° of the size, — 6,060 watts, so that it always consumes energy, just the same as mechanical friction always consumes energy.

Entirely different the conditions become, when large metal masses are near the inductive resistance.

Then the alternating magnetism intersecting these electric conductors induces E. M. F.'s therein, and these E. M. F.'s set up "eddy currents," or "Foucault currents," which in turn act in a magnetizing or inducing manner upon the main conductor of the inductive resistance.

Suppose, for instance, in Fig. 6, the M. M. F. of the eddy current G, equals one-quarter of the resulting M. M. F. F; that is, of that M. M. F., which produces the alternating magnetism

$$G = \frac{F}{4}$$

Then, as before, the magnetism M is not produced by the M. M. F. S of the main current C only, but by the M. M. F. F, which is the resultant of the M. M. F. S, of the main current, and the M. M. F. G, of the eddy currents.

Hence, if OF represents in the diagram (Fig. 6) the resulting M. M. F., then the M. M. F. of the eddy currents

$$OG = \frac{OF}{4}$$

lags one quarter of a period, or 90° behind OF, because it is produced by the E. M. F., induced by the magnetism M, which is equiphasized with OF, and, therefore, has the same phase as the induced E. M. F., OF being the resultant of OG and the M. M. F. OS of the main current, it must be the diagonal of the parallelogram of sine waves, which has OG and OS as its sides.

Hence, OG and OF being given, we produce the parallelogram OGFS, and therefrom get the M. M. F. OS of the main current.

It can be seen that if eddy currents are present the resulting M. M. F. F, and, therefore, the magnetism M, lags behind the M. M. F. of the main current S, by a certain angle d, which for $G = \frac{F}{4}$ is $\angle)\ d = 14°$, and increases for increasing amount of eddies.

TABLE A.

	(1.)	(2.)	(3.)	(4.)	(5.)
Angle of lag of magnetism behind impressed M. M. F. d=	0	14°	45°	76°	90°
Angle of lag of main current behind impressed E. M. F. ω=	53°	43°	21°	3°	0°
Induced E. M. F., E=	112	100	73	34	0 volts.
E. M. F. converted into heat by the resistance, H=	86	79	80	108	141 volts.
Current, C=	71	66	66	90	118 amperes.
Magnetism, M=	357,000	330,000	236,000	108,000	0 lines of magnetic force.
Resulting M. M. F., F=	3,570	3,300	2,360	1,080	0 ampere turns.
Impressed M. M. F., S=	3,570	3,295	3,320	4,505	5,900 ampere turns.
M. M. F. of eddy currents, G=	0	800	2,360	4,320	5,900 ampere turns.
Effective energy consumed by the inductive resistance. $\frac{VC\cos\omega}{2}$ =	3,030	3,400	4,865	6,370	8,350 watts.
Effective energy consumed by the induced E. M. F., that is, by the eddy currents. $\frac{EC\sin d}{2}$ =	0	790	1,720	1,500	0 watts.
Effective energy consumed by the ohmic resistance. $\frac{HC}{2}$ =	3,030	2,610	2,645	4,870	8,350 watts.

This "impressed M. M. F." OS is caused by a current OC, and this current consumes the E. M. F. OH, of opposite phase to OC, while the magnetism M caused by OF induces the E. M. F. OE, which reaches its maximum value 90° after OF.

OE combines with OH to the resulting E. M. F. OR by the law of the parallelogram, and this resulting E. M. F. OR is furnished by the impressed E. M. F. OV, of equal size but opposite phase.

Now, enlarging the diagram proportionally, so that the impressed E. M. F.—141.4 volts, that is, so that OV—2.83 inch, we get the diagram of the inductive resistance when acted upon by 100 volts effective E. M. F., under the condition that the M. M. F. of the eddy currents equals one-quarter of the resulting M. M. F.

In the same way we get the polar diagram of the inductive resistance for any other amount of eddy currents.

In Fig. 7 are given the diagrams of the electric quantities of this inductive resistance under the conditions:

(1.) If no eddy currents are induced.

(2.) If the M. M. F. of the eddy currents = ¼ of the resulting M. M. F.

(3.) If the M. M. F. of the eddy currents = the resulting M. M. F.

(4.) If the M. M. F. of the eddy currents = 4 times the resulting M. M. F.

(5.) If the M. M. F. of the eddy currents is infinitely larger than the resulting M. M. F.

The diagram (Fig. 7) gives the values of the electric quantities for the impressed E. M. F. of 100 volts effective, that is, 141.4 volts maximum value. (See Table A.)

It can be seen that as soon as eddy currents are induced the E. M. F. E lags more than 90° behind the current and lags more the more eddy currents are induced. Then the induced E. M. F. consumes energy; that is, the energy which is expended by the eddy currents.

Further, it can be seen that the eddy currents have the effect to cause a lagging of the magnetism behind the impressed M. M. F., or the main current, and that with increasing amount of eddies this angle of lag d increases.

The main current C decreases first slightly, keeps almost constant over a wide range, and then increases again, and rapidly approaches the value which it has for a non-inductive resistance.

If the self-induction of the inductance would be considerably larger, especially in comparison to its true ohmic resistance, the current would be much smaller if no eddies are induced, but would begin to increase right away—as soon as eddies are induced.

In Fig. 8 is given the diagram for the same five conditions of the inductive resistance, but when connected into a constant current circuit.

The current C = 71 amperes, maximum value; its "impressed" M. M. F. S = 3,570 ampere turns; the heating E. M. F. H = 86 volts, and the effective power consumed by the ohmic resistance $\frac{HC}{2}$ = 3,030 volts.

The angle d and $\bar{\omega}$ are the same as on constant potential circuit.

Then we derive from the diagram the values shown in Table B.

Here we see that with an increasing amount of eddies the resulting M. M. F. and, therefore, the magnetism steadily decreases, while the impressed E. M. F. and the effective power consumed by the inductive resistance first slightly increases, and then goes down again, to the value consumed by the true ohmic resistance.

From this diagrammatical representation of the alternate current wave, the result of changing one of the constants of the inductive resistance can be easily derived, for instance, n, or N, or σ.

In Fig. 9 is given the former diagram for no eddies, under (1). In (2) the diagram, if we change the number of turns to N = 100. In (3) the diagram, if we change the frequency to N = 200, or the magnetic conductivity to σ = 200 (both giving the same result), but leave the other constants unchanged.

It is seen that an increase of n acts in a similar way as an increase of N or σ, by increasing d, $\bar{\omega}$, E, decreasing C.

But an increase of n is much more effective than an increase of N or σ, because n enters the equations as n^2, but N and σ only in the first power.

We have noticed the fact, and made use thereof, that if the diagram is produced for any impressed E. M. F., by simply increasing or decreasing all the quantities proportionally, the diagram holds for any other value of impressed E. M. F.

This supposes that the "self-induction" of the inductance, that is, σ, is constant, and that no other losses of energy exist but the heat produced in the electric conductor by its resistance, and the energy consumed by the eddy currents. But this is true only when the inductive resistance contains no iron.

If iron is present in any large quantity, the magnetic conductivity of the inductance mainly consists of that of the iron, because iron has a much greater magnetic conductivity than air.

But the magnetic conductivity of iron is not constant, but depends upon the intensity of magnetization, that is, upon the strength of the magnetizing current, and, therefore, upon the impressed E. M. F.

It is a minimum for low magnetization, increases, reaches a maximum somewhere about 50,000 lines of magnetic force per square inch, and decreases again steadily, until at last—for enormously high magnetization—it is almost as poor as the conductivity of air.

Hence, if iron is present we are not allowed to apply the diagram for any other impressed E. M. F. by simply changing all the quantities proportionally.

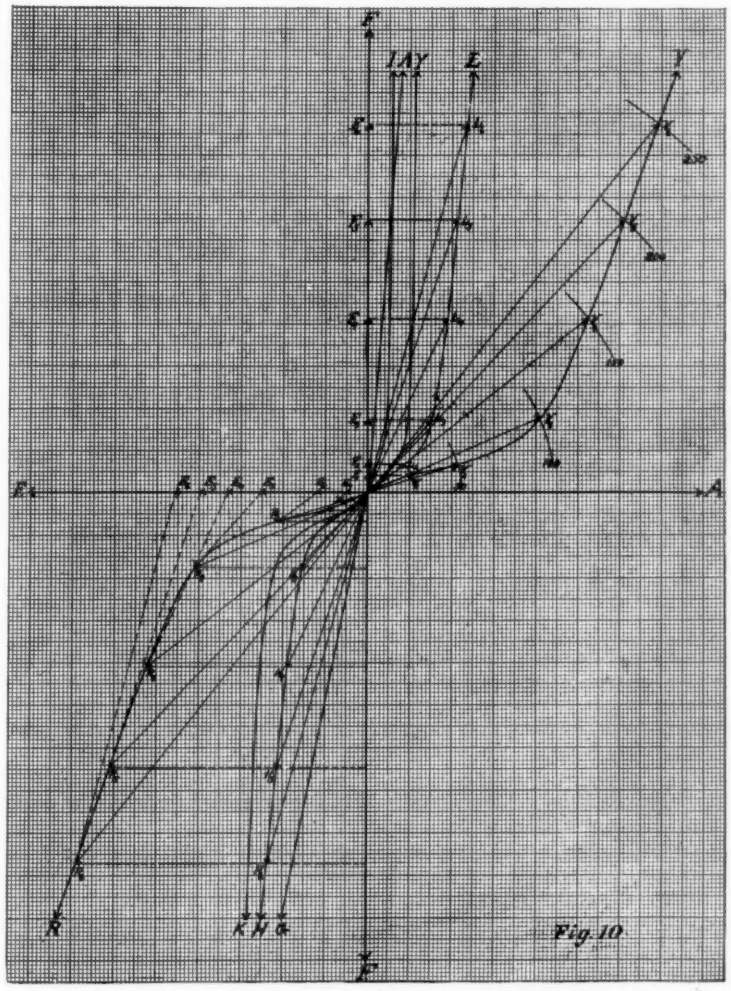
Still more complicated the consideration becomes by the phenomenon of *hysteresis*. Therefore, for an ironclad inductive resistance we proceed in the following way:

TABLE B.

	(1) G = 0.	(2) G = F/4	(3) G = F.	(4) G = 4F.	(5) G = x F.
Impressed E. M. F. = resulting E. M. F. V = R =	141	153	151	113	86 volts.
Induced E. M. F. E =	112	108	78	27	0 volts.
Magnetism, M =	357,000	346,000	252,000	86,400	0 lines of magnetic force.
Resulting M. M. F., F =	3,570	3,460	2,520	864	0 ampere turns.
M. M. F. of eddy currents, G =	0	8,161	2,520	3,460	3,570 ampere turns.
Effective power consumed by the inductive resistance. $\frac{VC \cos \bar{\omega}}{2}$ =	3,030	4,948	4,990	3,930	3,030 watts.
Effective power of the induced E. M. F., that is, of the eddy currents. $\frac{EC \sin d}{2}$ =	0	918	1,960	900	0 watts.

First, the *characteristic curve of the iron* has to be known; that is, the dependence of the magnetization upon the M. M. F., so that for any M. M. F. F we know the magnetism produced thereby, and therefrom the E. M. F. induced in the electric conductor by the alternating magnetism of the iron.

For this E. M. F. Ei is directly proportional to the magnetism M by the equation: $E = 2\pi n N M 10^{-8}$.



By means of this characteristic curve of the iron, Ei depends upon F, so that we can produce the characteristic in a somewhat different form, more suitable for use in the diagram, as the dependence of the induced E. M. F. Ei upon the M. M. F. F. Such a curve is drawn as K in the diagram Fig. 10.

There the M. M. F. F is represented by the perpendicular distance OF_1, while the E. M. F.'s induced thereby are given by the horizontal distances of the points of the curve K from the line OF_1.

But this E. M. F. Ei is not the only induced E. M. F. For in general the iron represents only a part, although the largest part, of the magnetic circuit; a certain number of lines of magnetic force are closed by the air.

Only in some entirely ironclad converters and similar apparatus the whole magnetism is inside of the iron and no air-field exists.

But if an air-field exists, it will induce an E. M. F. Ea, which the magnetic conductivity of the air being constant, is proportional to the M. M. F. F, so that Ea is represented by the horizontal distance of OF_1 from the straight line G.

Here another phenomenon comes in, the consumption of energy by *hysteresis*.

The energy, which is converted into heat by the hysteresis of the iron, is, so far as my tests have proved, and so far as I was able to determine it by calculations based upon Ewing's tests (see *Electrical Engineer*, December 17, 1890; London *Electrician*, January, 1891), *proportional to the* 1.6 *power of the magnetization*, that is, in our case, proportional to the 1.6 power of the induced E. M. F. Ei; $W = \varepsilon B^{1.6} = \eta E i^{1.6}$.

Hence, hysteresis can be represented by a current of equal, but opposite, phase to the induced E. M. F.

This current is proportional to the .6 power of the induced E. M. F. Ei. For the current will consume energy proportional to the 1.6 power of the induced E. M. F. Ei, that is, of the magnetization.

Therefore, we have to determine by experiment for one magnetization the energy consumed by hysteresis, and calculate the "*ideal hysteretic current*" for the induced E. M. F. Ei, corresponding to this magnetization. But the induced E. M. F. Ei depends upon the M. M. F. F by the characteristic curve of the iron, K.

Hence, the "ideal hysteretic current" depends upon the M. M. F. F, and can be represented by the horizontal distances of the points of a curve Y, from the perpendicular line OF, representing the M. M. F.

Therefrom we see, that hysteresis acts very similarly to eddy currents, causing a shifting of phase between magnetism and impressed M. M. F., with the only difference, that the eddy currents are proportional to the magnetization, but the ideal hysteretic current increases considerably slower than the magnetization.

Hence, hysteresis consumes proportionally more energy for low magnetization; eddy currents more for high magnetization.

The eddy currents induced by the alternating magnetism of the inductive resistance are represented in the same way as in the former diagrams, by an advance of phase of the impressed M. M. F. against the magnetism.

The eddy currents consist of two parts: Those induced by the magnetism of the air-circuit and those induced by the magnetism of the iron. Both parts are proportional to the intensity of the magnetism.

In the air-circuit the magnetism is proportional to the M. M. F. F.

Hence, these eddies and their M. M. F.'s are proportional to F, too, and, therefore, represented by a straight line A.

The M. M. F. of the eddies induced by the magnetism of the iron is proportional to this magnetism, and therefore to Ei, and gives a curve I, proportional to the induced E. M. F. Ei.

Adding together A, I and Y, we get the curve S, which represents the advance of phase of the impressed M. M. F. S against the resulting M. M. F. F, caused by eddy currents and hysteresis.

Now, this curve S gives for any value of F the value of S, by drawing a horizontal line through F, which intersects curve S in S, and connecting S with O.

From the impressed M. M. F. S we derive the current C, and therefrom the heating E. M. F. H, represented by the curve H, which is inversely proportional to curve S.

To the heating E. M. F. H correspond points on the curves K and G, giving the E. M. F.'s induced by the magnetic field in the iron, and by the magnetic air-field. These induced E. M. F.'s, produced horizontally from H, give the resulting E. M. F. R, on the curve of the resulting E. M. F.'s R, and equal thereto, but of opposite phase, the impressed E. M. F. V, on the congruent curve V.

We see that to produce the diagram of the ironclad inductive resistance, we have to know:

(1.) The characteristic curve of the iron.

(2.) The energy consumed by hysteresis in the iron, for one magnetization, or, what is the same, the coefficient ε in the formula of hysteresis, $W = \varepsilon B^{1.6}$.

(3.) The magnetic resistance of the air circuit, and the magnetic resistance of the iron circuit for one magnetization.

(4.) The M. M. F. of eddy currents for one magnetization.

Therefore, besides a knowledge of the characteristic curve of the iron, only data corresponding to one magnetization are required.

If in this way we have produced the curves V, R, H, etc., we derive the electric quantities for any value of impressed E. M. F. V, by drawing a circle with V as a radius, which intersects the congruent curves V and R in V and R, drawing RH as a horizontal line, then OE = RH is the induced E. M. F., OH the heating E. M. F., and ∠) ROH the shifting of phase between current and impressed E. M. F.

From H we derive the current C, the impressed M. M. F. S, the resulting M. M. F. F, etc., etc.

In Fig. 10 are given the electric quantities of this ironclad impedance for the impressed E. M. F.'s 25, 50, 100, 150, 200, 250 volts.

At the same time when starting, not from the impressed E. M. F. V, but from the current C, or rather its impressed M. M. F. S, we get the diagram of the impedance for a constant current circuit.

By varying the amount of eddies A, I, but retaining the other quantities constant, and keeping either the impressed E. M. F., or the impressed M. M. F., that is, the current, constant, similar as in Fig. 7 and 8, we derive the diagram of an ironclad impedance of variable amount of eddies, for a constant potential or a constant current circuit, that is, the diagram of the well known *choking coil*.

As seen from this, the phenomena in an ironclad inductive resistance are far more complicated than the phenomena in an impedance containing no iron, but can, nevertheless, be determined graphically in the polar diagram by the use of the characteristic curve of the iron.

Another Carbon Trust.

A St. Louis carbon candle manufactory, in a circular letter, informs its customers that it has reason to believe that a combination of electric carbon manufacturers has been formed. The trust, it is said, is composed of the National Carbon Company, of Cleveland, which recently bought the Boulton works after an assignment; the Standard, the Brush and the Thomson-Houston Companies, also of Cleveland, the Fidelity Carbon Manufacturing Company, of St. Louis, and the Faraday Carbon Company of Pittsburgh.

KINDRED INTERESTS

The Cleveland Motor Company has removed its New York office to the Ninth National Bank Building, 409 Broadway.

Merchant & Company, Philadelphia, devote one of their unique catalogues to the Star ventilator. This device should merit the attention of electric light station managers.

The Midland Electric Company, Denver, Colo., have removed from their former location, at 1517 and 1519 Larimer street, to 1616 and 1618 Seventeenth street, Denver.

Mr. J. Stanford Brown has taken Rooms 611 and 612 in the Electrical Exchange Building, New York, where he will carry on a general electrical engineering practice, devoting special attention to electric power work.

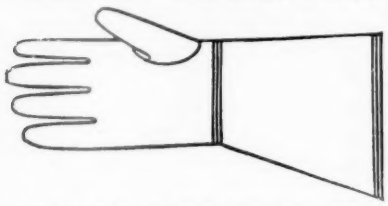
The Brown & Sharpe Manufacturing Company, Providence, R. I., have issued a very complete catalogue of their products. It is pocket size and tells about everything from a micrometer gauge to an annealing furnace.

The Jenney Electric Motor Company, Indianapolis, Ind., have issued a new catalogue of their constant potential motors, dynamos for incandescent lighting and power generators. A large number of very strong testimonials are included in the catalogue.

Central Electric Company.—As an indication that electrical construction is beginning to pick up in earnest, the Central Electric Company, Chicago, report a largely increased demand for soldering torches of various kinds. This company carries a large assortment of these goods and handle all the most approved styles.

The new machine shop for the Ball & Wood Company, at Elizabethport, N. J., is fast approaching completion. The building is made of brick and iron, designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn., and will be used by the Ball & Wood Company for a machine shop. The central portion is 40 feet wide, with a wing on each side 20 feet wide, the entire central portion of the building being served by a traveling crane driven by electricity. This promises to be one of the most complete machine shops in the Eastern States.

Accidents can be avoided if linemen will use rubber gloves when at work on live circuits. This cut shows one of the styles of gloves made by Goodyear's India Rubber Glove Manufacturing Company,



503 and 505 Broadway, New York. Central station managers should give the matter of rubber gloves their early attention, if they have not done so already.

The Ball Engine Company, Erie, Pa., have received the following:

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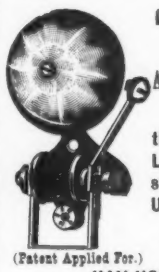

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON JUNE 9, 1891.

453,618 Electric cigar lighter; Harrison B. Brown, Washington, D. C., assignor of one-half to William W. Dudley and Frank L. Browne, both of same place.

453,633 Electric switch; Lawrence F. Furlong and Frederick O. Tucker, Hartford, Conn., said Furlong assignor to Amos Whitney and Seth W. Bishop, both of same place.

453,681 Electrical measuring instrument; Frank C. Wagner, Ann Arbor, Mich.

453,693 Electric arc lamp; Josiah W. Ells, Pittsburgh, Pa., assignor of one-half to Henry B. Smithson, same place, and William S. Bostwick, Allegheny, Pa.

453,695 Secondary battery; William W. Griscom, Haverford College, Pa.

453,710 Electric railway; John Jones, New York, N. Y.

453,722 Attachment for telephones; Edward E. Baker, Pittsburgh, Pa.

453,723 Electric fire alarm; Michael M. Braun, Allegheny, Pa.

453,729 Coin-freed dynamometer; Charles A. Barrett, London, England.

453,733 Electric conduit; John E. Price, Denver, Colo.

453,741 Phonograph; Thomas A. Edison, Llewellyn Park, N. J.

453,742 Manufacture of incandescent electric lamps; Reginald A. Fessenden, Rossville, N. J.

453,858 Commutator for dynamo-electric generators and motors; Henry Davis and Arthur H. Stokes, Derby, England.

453,863 Distributing frame for electric conductors; Angus S. Hibbard, Morristown, N. J., assignor to the American Telephone and Telegraph Co., of New York.

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